

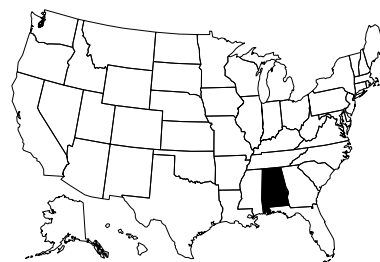
3. PROGRAM SUMMARIES

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ALABAMA

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Program Description

In the last five years the Alabama Department of Environmental Management (ADEM) has assessed more than 1,100 river and stream locations as a part of six major long-term riverine-focused monitoring programs:

- Nonpoint Source Assessment Program
- Source Assessment Program
- Ecoregion Reference Assessment Program
- Upland Almap Monitoring and Assessment Program
- Clean Water Act §303(d) Support Assessment/Monitoring Program
- Fixed Ambient Trend Monitoring Program

The Field Operations Division's (FOD) benthic macroinvertebrate assessment program is an integral part of the Department's biological monitoring effort. A Multihabitat Bioassessment Protocol is currently utilized to sample wadeable and nonwadeable streams. All methods utilized are documented in the Department's *Standard Operating Procedures and Quality Control Assurance Manual, Volume II* (ADEM 1999).

The Department has developed assessment criteria based on a ten-year ecoregional reference database. These assessments are then used to determine the Aquatic Life Use Designations. These comparisons have aided the Department in evaluating the "best attainable biotic community" within an ecoregion. The Department uses macroinvertebrates and a multi-habitat fish community assessment to evaluate water quality. Periphyton bioassessment methods are currently being tested as a more direct assessment of nutrient enrichment.

Biological integrity and water quality are directly affected by physical habitat. In addition, the assessment of habitat quality is an important step in documenting the adverse impacts of nonpoint source pollution. The Department utilizes the Habitat Assessment Matrices developed by EPA (USEPA 1989) and Barbour and Stribling (1994) in conjunction with physical characteristics and water quality parameters to evaluate and document the habitat quality of each wadeable bioassessment sampling site. More intensive assessment of geomorphological survey methods are currently being implemented (in 2002) to evaluate sedimentation impacts.

Through contracts and cooperative efforts, other agencies have contributed valuable information, time, data, and other resources to the surface and ground water management program. These contributions have included sampling and analysis efforts; flow information; data contribution and management; and GIS development. The Alabama Water Watch (AWW) Program and Association routinely provides quality citizen volunteer monitoring data to ADEM. With so much water to manage and diminishing program funds, the "Alabama Water Watchers" play a key role in identifying waters that need immediate or long-term attention.

Documentation and Further Information

2000 Water Quality Report to Congress, 305(b) Report:
<http://www.adem.state.al.us/WaterDiv/Water%20Quality%20Info/305b/WQ305bReport.htm>

1996, 1998 and 2000 303(d) lists, listing and delisting criteria, and maps of listed waters:
<http://www.adem.state.al.us/WaterDiv/Water%20Quality%20Info/303d/WQ303d.htm>

ADEM. 1999. *Standard Operating Procedures and Quality Control Assurance Manual Volume II – Freshwater Macroinvertebrate Biological Assessment*. Field Operations Division ADEM, Montgomery, Alabama.

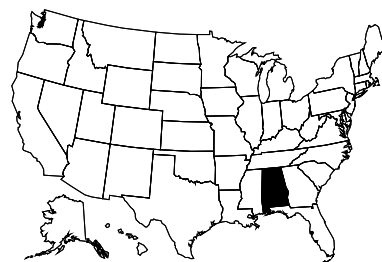
O'Neil, P.E., and T.E. Shepard. 1998. *Standard operating procedure manual for sampling freshwater fish communities and application of the index of biotic integrity for assessing biological condition of flowing, wadeable streams in Alabama*. ADEM Contract No. AGY7042. Geological Survey of Alabama, Tuscaloosa, Alabama.

Barbour, M.T., and J.B. Stribling. 1994. A technique for assessing stream habitat structure. Pages 156-178 in *Conference proceedings, Riparian ecosystems in the humid U.S.: Functions, values, and management*. National Association of Conservation Districts, Washington, D.C. March 15-18, 1993, Atlanta, Georgia.

ALABAMA

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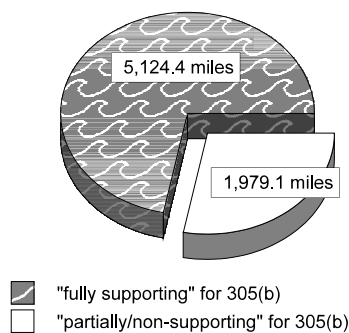
Programmatic Elements

Uses of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input checked="" type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input type="checkbox"/>	other: _____
Applicable monitoring designs	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) (<i>special projects and specific river basins or watersheds</i>)
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) (<i>special projects and comprehensive use throughout jurisdiction</i>)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin (<i>special projects and specific river basins or watersheds</i>)
	<input type="checkbox"/>	other: _____

Stream Miles

Total miles	77,274
Total perennial miles	47,077
Total miles assessed for biology*	7,103.5
fully supporting for 305(b)	5,124.4
partially/non-supporting for 305(b)	1,979.1
listed for 303(d)	1,979.1
number of sites sampled (<i>on an annual basis</i>)	200
number of miles assessed per site	—

7,103.5 Miles Assessed for Biology



*The above miles are the total river and stream miles assessed for biological *and* other (chemical, physical, etc.) effects. Strictly biological miles are as follows: 2,992.1 *monitored* miles and 5,524 *evaluated* miles were determined as "fully supporting" for 305(b) using bioassessment data. These miles do not include fish tissue monitoring data from streams and rivers.

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Fishery Based Uses	
ALU designations in state water quality standards	Three designations: Outstanding Alabama Water, Fish & Wildlife, Limited Warmwater Fishery	
Narrative Biocriteria in WQS	none - A narrative scale of condition is used to support criteria decisions. Draft guidelines, based upon ecoregional reference conditions, are used in the evaluation of aquatic macroinvertebrate community assessments.	
Numeric Biocriteria in WQS	none	
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input checked="" type="checkbox"/>	permitted discharges
	<input checked="" type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	none	

Reference Site/Condition Development

Number of reference sites	48 total	
Reference site determinations	<input type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input checked="" type="checkbox"/>	regional (aggregate of sites)
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Reference site criteria	Local Soil and Water Conservation District (SWCD) estimates of landuse, animal densities, and sedimentation rates, etc. and departmental databases are used to identify potentially least-impaired sub-watersheds.	
Characterization of reference sites within a regional context	<input type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Stream stratification within regional reference conditions	<input checked="" type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input type="checkbox"/>	other:
Additional information	<input checked="" type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

Field and Lab Methods

Assemblages assessed	<input checked="" type="checkbox"/>	benthos (100-500 samples/year; multiple seasons, multiple sites - broad coverage for watershed level)
	<input checked="" type="checkbox"/>	fish (<100 samples/year; multiple seasons, multiple sites - broad coverage for watershed level)
	<input type="checkbox"/>	periphyton (currently being tested for assessment of nutrient enrichment)
	<input checked="" type="checkbox"/>	other: phytoplankton (100-500 samples/year; multiple seasons, multiple sites - broad coverage for watershed level)
Benthos		
sampling gear		wash bucket, dipnet and kick net (1 meter); 500-600 micron mesh
habitat selection		multihabitat
subsample size		100 per habitat
taxonomy		family and genus
Fish		
sampling gear		backpack electrofisher and seine; 3/16" mesh
habitat selection		pool/glide and riffle/run (cobble)
sample processing		biomass - batch
subsample		none
taxonomy		species
Habitat assessments		visual based; performed both with, and independent of, bioassessments
Quality assurance program elements		standard operating procedures, quality assurance plan, periodic meetings and training for biologists, sorting and taxonomic proficiency checks, specimen archival

Data Analysis and Interpretation

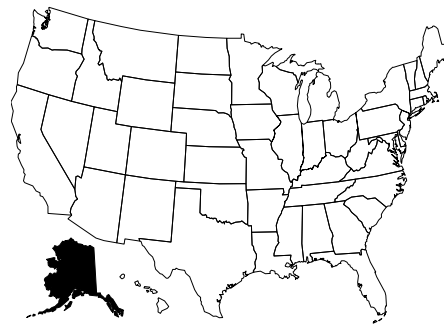
Data analysis tools and methods	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics (<i>aggregate metrics into an index and return single metrics</i>)
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
Multimetric thresholds		
transforming metrics into unitless scores		95 th percentile of reference population
defining impairment in a multimetric index		The 2000 305(b) report states that sampling results equal to or less than fair/moderately impaired for the macroinvertebrate index and chemical/physical field data indicate an impairment ("excellent, good, fair, poor, very poor" or "unimpaired, slightly impaired, moderately impaired, severely impaired") and will be considered non-support and placed on the 303(d) list.
Evaluation of performance characteristics	<input checked="" type="checkbox"/>	repeat sampling (<i>sampling - multiple crews same site/same day</i>)
	<input checked="" type="checkbox"/>	precision (<i>sampling, assessment and identification</i>)
	<input checked="" type="checkbox"/>	sensitivity (<i>sampling and assessment; standard level of identification</i>)
	<input checked="" type="checkbox"/>	bias (<i>identification - 10% peer review</i>)
	<input checked="" type="checkbox"/>	accuracy (<i>identification - 10% peer Quality Assurance; lab pick - 100% recheck; field pick - 10% returned to lab for re-check</i>)
Biological data*		
Storage		Aquatic macroinvertebrate data from 1990 to present are stored in a PACE mainframe database. ADEM has very recently developed an MS Access Fish IBI database and will begin data entry of this information as time allows. Historical macroinvertebrate data are stored in paper files. Fish IBI data are mostly in spreadsheets, but will eventually be included in the Access database.
Retrieval and analysis		Both databases mentioned above include automated metric calculation. The macroinvertebrate database also allows some comparison of taxa lists between stations.

*Additional resources are necessary to develop an in-house biological database module in Oracle that would be compatible with the Oracle Surface Water Quality Database currently under development. The current aquatic macroinvertebrate dataset and the fish community data would be migrated into this database module. STORET will not be used as the primary biological data storage and retrieval system.

ALASKA

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http://www.state.ak.us/local/akpages/ENV.CONSERV/dawq/dec_dawq.htm



Program Description

The State of Alaska is in the early stages of using bioassessments in water quality management. The lead agency funding bioassessment work is the Alaska Department of Environmental Conservation (ADEC); with the bulk of the development work done by the University of Alaska (UAA) Environment and Natural Resources Institute (ENRI). To date, bioassessments have not been used for biocriteria. Key accomplishments of Alaska's program include:

- method development and testing, resulting in the Alaska Stream Condition Index
- successful interagency involvement and supplemental funding
- extensive outreach and educational opportunities
- development of regional reference conditions for the Cook Inlet Ecoregion
- stream type differences incorporated into the framework for assessment
- index development incorporating multiple community attributes
- water quality assessments for Cook Inlet Ecoregion
- database development compatible with STORET for the water quality information
- relationship between degradation and habitat quality
- nutrient enrichment issues
- impervious surface areas influences to water quality

Documentation and Further Information

Alaska's bioassessment program is being developed in conjunction with UAA-ENRI. For consistency and to avoid duplicate information, refer questions on protocols and reference sites to them. Their web site is:
<http://www.uaa.alaska.edu/enri/bmap>

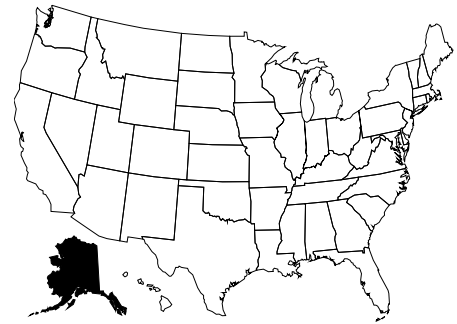
Alaska Stream Condition Index: Biological Index Development for Cook Inlet, Summary 1997 - 2001, August 2001:
http://www.uaa.alaska.edu/enri/bmap/pdfs/AK_SCI_2001.pdf

Quality Assurance Project Plan, Alaska Biological Monitoring and Assessment Program, February 2002:
http://www.uaa.alaska.edu/enri/bmap/pdfs/ENRI_QAPP_2-02.pdf

ALASKA

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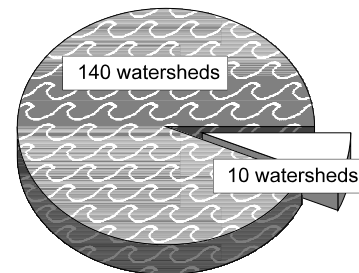
Programmatic Elements

Uses of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input type="checkbox"/>	monitoring the effectiveness of BMPs
	<input type="checkbox"/>	ALU determinations/ambient monitoring
	<input type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
Applicable monitoring designs	<input type="checkbox"/>	other:
	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) <i>(comprehensive use throughout jurisdiction, special projects and specific river basins or watersheds)</i>
	<input type="checkbox"/>	fixed station (i.e., water quality monitoring stations)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input type="checkbox"/>	rotating basin
	<input type="checkbox"/>	other:

Stream Miles

Total miles <i>(determined using National Hydrography Database)</i>	>3 million
Total perennial miles	unknown
Total watersheds assessed for biology	150
watersheds fully supporting for 305(b)	140
watersheds partially/non-supporting for 305(b)	10
watersheds listed for 303(d)	10
number of sites sampled	300
number of miles assessed per site*	10

150 Watersheds Assessed for Biology



- ☒ "fully supporting" for 305(b)
- ☐ "partially/non-supporting" for 305(b)

*For the purposes of decision making, a 100 meter reach represents approximately 10 stream miles.

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Class system (A,B,C)—Every AK stream is designated for ALL uses (including drinking water) unless specifically exempted.	
ALU designations in state water quality standards	One designation in A: 3) aquaculture; One designation in C: 1) growth and propagation of fish, shellfish, other aquatic life, and wildlife	
Narrative Biocriteria in WQS	none	
Numeric Biocriteria in WQS	none	
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input type="checkbox"/>	cause and effect determinations
	<input type="checkbox"/>	permitted discharges
	<input checked="" type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
Uses of bioassessment/ biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	Alaska is just beginning to use bioassessment information to help with assessment/monitoring and in management decisions.	

Reference Site/Condition Development

Number of reference sites	43 total	
Reference site determinations	<input checked="" type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input type="checkbox"/>	regional (aggregate of sites)
	<input checked="" type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Reference site criteria	no channelization; no upstream impoundments; no known point-source discharges; DO > 5 ppm; urban land use <15% in catchment; mining or logging in <15% of catchment; forest or natural land use >50% in catchment; riparian buffer width >18m	
Characterization of reference sites within a regional context	<input type="checkbox"/>	historical conditions
	<input type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input checked="" type="checkbox"/>	other: minimally disturbed*
Stream stratification within regional reference conditions	<input checked="" type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input checked="" type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input type="checkbox"/>	other:
Additional information	<input checked="" type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input type="checkbox"/>	some reference sites represent acceptable human-induced conditions

*Alaska's reference sites are considered "minimally" disturbed; variation in results is due to natural and environmental influences.

Field and Lab Methods

Assemblages assessed	<input checked="" type="checkbox"/>	benthos (100 to 500 samples/year; single and multiple seasons, multiple sites - broad coverage)
	<input type="checkbox"/>	fish
	<input type="checkbox"/> UD	periphyton
	<input type="checkbox"/>	other:
Benthos		
sampling gear	d-frame; 200 - 400 micron mesh	
habitat selection	multihabitat	
subsample size	300-count target	
taxonomy	genus level	
Habitat assessments	visual based, hydrogeomorphology; performed with bioassessments	
Quality assurance program elements	standard operating procedures, quality assurance plan (in progress), periodic meetings and training for biologists, sorting and taxonomic proficiency checks, specimen archival	

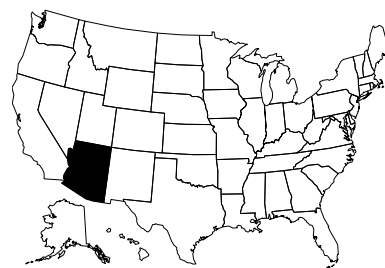
Data Analysis and Interpretation

Data analysis tools and methods	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics (<i>aggregate metrics into an index</i>)
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
Multimetric thresholds		
transforming metrics into unitless scores	95 th percentile of all sites	
defining impairment in a multimetric index	first quartile from the 95 th percentile	
Evaluation of performance characteristics	<input type="checkbox"/>	repeat sampling
	<input checked="" type="checkbox"/>	precision (<i>sampling replicates</i>)
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
Biological data		
Storage	EDAS	
Retrieval and analysis	EDAS	

ARIZONA

Contact Information

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Program Description

The Biocriteria Program at the Arizona Department of Environmental Quality (ADEQ) has been sampling benthic macroinvertebrates since 1992. Data has been collected for biocriteria standards development and 305(b) assessment purposes for the past ten years. ADEQ has only one dedicated biocriteria staff person, however six other water quality monitoring staff assist in biological data collection during the spring as part of the ambient watershed monitoring program.

ADEQ does not yet have narrative or numeric biocriteria. However, sampling methods and Indexes of Biological Integrity have been developed with the assistance of USEPA and contractor support. The cold and warm water Indexes of Biological Integrity will be used to support two designated uses, Aquatic and Wildlife (cold water fishery) (A&Wc) and Aquatic and Wildlife (warm water fishery) (A&Ww), which are currently listed in Arizona's surface water quality standards. ADEQ plans to develop a narrative biocriterion for the next triennial review of standards and these indexes will serve as the implementation guidance for such a standard. ADEQ has also developed an approach to using bioassessments plus habitat assessments to implement the narrative bottom deposit standard, which will be proposed during a separate rulemaking on implementation guidance documents for all narrative standards during 2002.

In the water quality standards rules that are currently under review by USEPA, ADEQ has updated definitions for A&Wc and A&Ww based upon "macroinvertebrate regions" identified in Spindler 2001. The 5000' elevation contour marks the threshold for a change in community type from warm to cold, as determined by statistical analysis of empirically derived statewide biological data. These macroinvertebrate regions will be used instead of ecoregions for predicting community types in Arizona. Addition of the elevation range in the A&Wc and A&Ww standards definitions allows Arizona to use the elevation model to better predict the correct A&W use type. Revisions to the "list of surface waters and designated uses" have correspondingly been made in the 2001 standards rule.

ADEQ does not have a biocriteria standard and has subsequently been unable to assess biological integrity in Arizona's 305(b) report or 303(d) list. As a result of a lawsuit, ADEQ is preparing an "impaired waters rule" this year which will specifically outline assessment and listing procedures. Rules for conducting bioassessments will also have to be developed as part of this impaired waters rule, in addition to the surface water quality standard before bioassessments can be fully implemented in our assessment and listing process in Arizona. ADEQ is also partnering with the US Forest Service and Bureau of Land Management to standardize macroinvertebrate sample collection and analysis methods in order to share data on this important ecosystem indicator.

Future program directions include refining narrative bottom deposit standard implementation guidance for rule development, developing narrative biocriterion, starting a diatom bioassessment pilot project, refining reference condition, and developing bioassessments for intermittent streams and large rivers.

Documentation and Further Information

Status of Water Quality In Arizona - Clean Water Act Section 305(b) Report: June 2000:
<http://www.adeq.state.az.us/environ/water/assess/305/index.html>

Draft Status of Water Quality in Arizona - 2002, Arizona's Integrated 305(b) Assessment and 303(d) Listing Report:
<http://www.adeq.state.az.us/environ/water/assess/hsa.html#draft>

WQD Biocriteria Program information: <http://www.adeq.state.az.us/environ/water/assess/monit.html>

ADEQ. 2001. *DRAFT Quality Assurance Program Plan for the Biocriteria Program*. ADEQ, Phoenix, AZ.

Spindler, P.H. 2001. *DRAFT Narrative bottom deposit standard implementation guidelines for Arizona*. ADEQ, Phoenix, AZ.

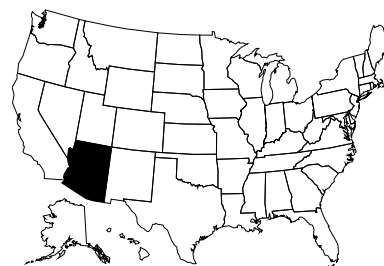
Spindler, P.H., 1996. *Using ecoregions for explaining macroinvertebrate community distribution among reference sites in Arizona*, 1992. ADEQ OFR-95-7, Phoenix, AZ.

Other accomplishments include macroinvertebrate community distribution among reference sites in AZ (2001), development of Arizona EDAS biological database (2001), development and testing of a biological index for coldwater streams of AZ (2000), development and testing of a biological index for warmwater streams of AZ (1998), and Macroinvertebrate Photocatalog on CD (1998).

ARIZONA

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Programmatic Elements

Uses of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	UD	nonpoint source assessments
	UD	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	UD	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input type="checkbox"/>	other:
Applicable monitoring designs	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) (<i>special projects, specific river basins or watersheds</i>)
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) (<i>comprehensive use throughout jurisdiction</i>)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin (<i>specific river basins or watersheds</i>)
	<input type="checkbox"/>	other:

Stream Miles

Total miles	127,505
Total perennial miles	4,980
Total miles assessed for biology*	0
fully supporting for 305(b)*	n/a
partially/non-supporting for 305(b)*	n/a
listed for 303(d)*	n/a
number of sites sampled	324
number of miles assessed per site	site specific

*Arizona does not have formal biocriteria and will not be using bioassessments in the 2002 305(b) or 303(d) reports. However, a proposal to use bioassessment plus habitat assessment as the implementation procedure for the narrative bottom deposit standard will be considered during a rulemaking (2002-03), which is separate from the just completed triennial review of standards. The next 305(b) report may include bioassessments in support of the narrative bottom deposit standard, if this implementation procedure is approved.

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Warm water vs. Cold Water	
ALU designations in state water quality standards	Aquatic and Wildlife (A&W) cold, A&W warm, A&W-effluent dependent water, A&W-ephemeral (AZ has acute and chronic categories for each except ephemeral in which only acute applies.)	
Narrative Biocriteria in WQS	under development – ADEQ has developed a cold water and warm water Index of Biological Integrity to support these two designated uses, which are currently listed in the surface water quality standards. However ADEQ does not yet have established biocriteria. These indexes will become the implementation guidance for proposed biocriteria in the next triennial review of standards.	
Numeric Biocriteria in WQS	none	
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input type="checkbox"/> UD	assessment of aquatic resources
	<input type="checkbox"/> UD	cause and effect determinations
	<input type="checkbox"/> UD	permitted discharges
	<input checked="" type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input type="checkbox"/>	watershed based management
Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	none	

Reference Site/Condition Development

Number of reference sites	89 total	
Reference site determinations	<input type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input checked="" type="checkbox"/>	regional (aggregate of sites)
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Reference site criteria	For initial site selection, the following guidelines were used in the early 1990s: a site must be accessible (within a 2-hour walk or 3-4 miles from nearest 4-wheel drive road), > 0.5 km downstream of road crossings, no known discharges upstream, no major impoundments upstream, no channel alterations at the site, and be only minimally impacted by land use activities and nonpoint sources. All of the following criteria must be attained in the field assessment of potential sites for a site to be accepted as reference: site should be truly perennial (indicators: fish, univoltine insects, riparian indicators), site should be free of local land use impacts, site should be free of channel alterations, no violations of pH or dissolved oxygen water quality standards, and habitat assessment index score > 14 using ADEQ's 2001 5-parameter habitat index.	
Characterization of reference sites within a regional context	<input type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input checked="" type="checkbox"/>	professional judgment
Stream stratification within regional reference conditions	<input checked="" type="checkbox"/>	other: minimally disturbed
	<input type="checkbox"/>	ecoregions (or some aggregate)
	<input checked="" type="checkbox"/>	elevation
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
Additional information	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input type="checkbox"/>	other:
	<input checked="" type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

Field and Lab Methods

Assemblages assessed	<input checked="" type="checkbox"/>	benthos (<100 samples/year; single season, multiple sites - watershed level)
	<input type="checkbox"/>	fish
	<input checked="" type="checkbox"/>	periphyton (<100 samples/year; single season, multiple sites - watershed level)
	<input type="checkbox"/>	other:
<hr/>		
Benthos		
sampling gear		d-frame net; 500 micron mesh
habitat selection		riffle/run (cobble)
subsample size		500 - 600 count target
taxonomy		combination level; EPT taxa are identified to genus or species
<hr/>		
Periphyton		
sampling gear		natural substrate: brushing/scraping device (razor, toothbrush, etc.) artificial substrate: microslides or other suitable substratum
habitat selection		riffle/run (cobble); artificial substrate
sample processing		taxonomic identification
taxonomy		diatoms only; identified at species level
<hr/>		
Habitat assessments		visual based, quantitative measurements, hydrogeomorphology; performed with bioassessments
<hr/>		
Quality assurance program elements		standard operating procedures, quality assurance plan, periodic meetings, training for biologists, sorting and taxonomic proficiency checks, and specimen archival

Data Analysis and Interpretation

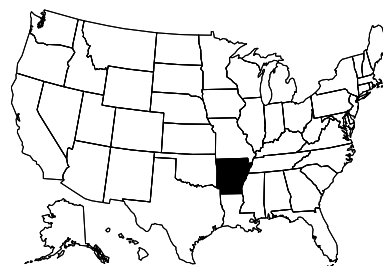
Data analysis tools and methods	<input type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics (<i>aggregate metrics into an index</i>)
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<hr/>		
Multimetric thresholds		
transforming metrics into unitless scores		95 th percentile of reference population
defining impairment in a multimetric index		25 th percentile of reference population
<hr/>		
Evaluation of performance characteristics*	<input checked="" type="checkbox"/>	repeat sampling (<i>duplicate samples collected for 10% of sites annually</i>)
	<input type="checkbox"/>	precision
	<input checked="" type="checkbox"/>	sensitivity (<i>standard level of identification used by lab</i>)
	<input checked="" type="checkbox"/>	bias (<i>ADEQ uses a standard mesh size, the lab locates small organisms, using a 6-12x dissecting microscope and a Caton tray to randomly obtain fractions of the total sample</i>)
	<input checked="" type="checkbox"/>	accuracy (<i>any questionable identifications are sent to nationally recognized taxonomic experts for confirmation and a voucher specimen collection is maintained</i>)
<hr/>		
Biological data		
Storage		AZ-EDAS
Retrieval and analysis		Systat, EDAS

*Though multiple performance characteristics are evaluated, ADEQ has not incorporated this information into a QA/QC document.

ARKANSAS

Contact Information

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Program Description

As part of the Water Division of the Arkansas Department of Environmental Quality (ADEQ), the Water Quality Planning Branch has seven biologists/ecologists and two geologists on staff. This branch deals with a variety of issues related to water quality monitoring, standards development, and groundwater and wasteload allocations. The Branch is responsible for conducting water quality surveys, assessing the State's water quality for surface and ground water, and 305(b) reporting. The Branch is also responsible for the development of water quality and biological criteria for water quality use attainability analysis and for water quality standards development. In addition, the Branch is responsible for developing TMDLs (303d) for those waters not meeting water quality standards. Finally, the Branch is responsible for the biomonitoring aspect of the NPDES program.

Biological and habitat monitoring are currently restricted to special project needs associated with synoptic watershed surveys or for the development of additional data to support the establishment of biological criteria. For the 2000 305(b) report, portions of 106 stream segments from 17 planning segments were assessed for aquatic life use support using biological communities. These stream segments were either located above or below a point source discharge, or were part of intensive water quality surveys. Survey objectives were to determine the impacts of the discharge, evaluate the biological community in ecoregional reference streams, determine use attainment in previously listed water bodies of concern or those waters not currently meeting all designated uses.

Macroinvertebrates were collected and evaluated following EPA's *Rapid Bioassessment Protocols* (USEPA 1989). Habitat considerations were used in the evaluation of the macroinvertebrate communities through percent comparability evaluation techniques at all sites. An upstream-downstream comparison of the communities, and a comparison of the community to a least disturbed reference stream were also used to make the assessments. Fish communities were analyzed following EPA's *Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analysis* (USEPA 1983). Direct comparisons were made with ecoregional fish community data outlined in the Department's *Physical, Chemical, and Biological Characteristics of Least-Disturbed Reference Streams in Arkansas' Ecoregions*, 1987. In addition, an upstream-downstream comparison of the communities was made and compared to a least-disturbed reference stream.

Documentation and Further Information

Water Quality Inventory Report 2000, 305(b) Report:
[http://www.adeq.state.ar.us/water/pdfs/documents/305\(b\)_2000.pdf](http://www.adeq.state.ar.us/water/pdfs/documents/305(b)_2000.pdf)

2002 Proposed 303(d) List: [http://www.adeq.state.ar.us/water/pdfs/documents/303\(d\)_list_proposed_020426.pdf](http://www.adeq.state.ar.us/water/pdfs/documents/303(d)_list_proposed_020426.pdf)

1998 Arkansas 303(d) List: <http://www.adeq.state.ar.us/water/303drprt.htm>

Water Quality Standards for Surface Waters, effective Feb. 1998, amended January 2001:
http://www.adeq.state.ar.us/regq/files/reg02_final_010917.pdf

Physical, Chemical, and Biological Characteristics of Least-Disturbed Reference Streams in Arkansas' Ecoregions, Volume 1: *Data Compilation*, and Volume 2: *Data Analysis*. ADEQ Water Division. 1987.

Water Quality Planning Branch, list of publications: <http://www.adeq.state.ar.us/water/pdfs/documents/publist.pdf>

ARKANSAS

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Programmatic Elements

Uses of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input checked="" type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input type="checkbox"/>	other:
Applicable monitoring designs	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) (<i>special projects and specific river basins or watersheds</i>)
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin
	<input type="checkbox"/>	other:

Stream Miles

Total miles	87,617
<i>(determined using RF3 and the National Hydrography Database)</i>	
Total perennial miles	28,408
Total miles assessed for biology*	245
	stream segments
fully supporting for 305(b)	n/a
partially/non-supporting for 305(b)	n/a
listed for 303(d)	n/a
number of sites sampled (<i>on an annual basis</i>)	~450
number of miles assessed per site	—

*Currently, biological monitoring occurs as either 1) part of intensive watershed survey where water quality problems have been previously identified; 2) part of a site specific survey, wasteload allocation; and 3) most recently as part of expanding ecoregion reference stream data. Biological data are not used to list any 303(d) waters.

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Single Aquatic Life Use, Fishery Based Uses and Warm Water vs. Cold Water	
ALU designations in state water quality standards	Two designations: Ecologically sensitive waterbodies protecting endangered, threatened, and endemic aquatic species. Fisheries are divided into Trout, Lakes and Reservoirs, and Streams (further subdivided by ecoregion).	
Narrative Biocriteria in WQS	Procedures used to support narrative biocriteria are currently found in the project specific QAPP. Additional methods and SOPs are being developed. NOTE: The development of criteria and standards is ongoing.	
Numeric Biocriteria in WQS	none	
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input checked="" type="checkbox"/>	permitted discharges
	<input type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	Currently, baseline data has been collected from numerous locations prior to BMP implementation and NPDES limit changes. Follow-up monitoring has occurred at some locations below point sources. No follow-up monitoring has occurred at nonpoint source locations.	

Reference Site/Condition Development

Number of reference sites	75 total	
Reference site determinations	<input checked="" type="checkbox"/>	site-specific
	<input checked="" type="checkbox"/>	paired watersheds
	<input checked="" type="checkbox"/>	regional (aggregate of sites)
	<input checked="" type="checkbox"/>	professional judgment
	<input checked="" type="checkbox"/>	other: upstream/downstream
Reference site criteria	Water quality and habitat is typical of background ecoregion conditions. Watershed is somewhat undisturbed.	
Characterization of reference sites within a regional context	<input checked="" type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input checked="" type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Stream stratification within regional reference conditions	<input checked="" type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input checked="" type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input checked="" type="checkbox"/>	other: watershed size, habitat, water quality
Additional information	<input checked="" type="checkbox"/>	reference sites linked to ALU
	<input checked="" type="checkbox"/>	reference sites/condition referenced in water quality standards (found in ADPC&E 1987 - WQ87-06-01 & 02)
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

Field and Lab Methods

Assemblages assessed	<input checked="" type="checkbox"/>	benthos (<i>100-500 samples/year; single season, multiple sites - watershed level and broad coverage; multiple seasons, multiple sites</i>)
	<input checked="" type="checkbox"/>	fish (<i><100 samples/year; single season, multiple sites - watershed level and broad coverage</i>)
	<input type="checkbox"/>	periphyton
	<input type="checkbox"/>	other:
Benthos		
sampling gear		D-frame; 200-400 micron mesh
habitat selection		riffle/run (cobble), multihabitat and woody debris
subsample size		100 count
taxonomy		combination - family, genus and species
Fish		
sampling gear		backpack and boat electrofisher, pram unit (tote barge) and seine; 3/16" and 1/4" mesh
habitat selection		pool/glide, riffle/run (cobble), and multihabitat
sample processing		anomalies
subsample		whole samples are sorted and identified to species
taxonomy		species and life stage
Habitat assessments		visual based with limited quantitative measurements and hydrogeomorphology, pebble counts, flows and canopy cover; performed with bioassessments
Quality assurance program elements		quality assurance plan, periodic meetings and training for biologists, sorting and taxonomic proficiency checks, specimen archival, and standard operating procedures (in development stage)

Data Analysis and Interpretation

Data analysis tools and methods	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input checked="" type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics (<i>aggregate metrics into an index and return single metrics - use endpoint for each single metric</i>)
	<input checked="" type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
Multimetric thresholds		
transforming metrics into unitless scores		As a percent of either the reference site or based on ecoregion data dependent upon standard deviation units
defining impairment in a multimetric index		As a percent of either the reference site or based on ecoregion data dependent upon standard deviation units
Multivariate thresholds		
defining impairment in a multivariate index		As a percent of either the reference site or based on ecoregion data dependant upon standard deviation units
Evaluation of performance characteristics <i>Not currently evaluated</i>	<input type="checkbox"/>	repeat sampling
	<input type="checkbox"/>	precision
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
Biological data		
Storage		Microsoft databases
Retrieval and analysis		none

CALIFORNIA

Contact Information

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website: <http://www.swrcb.ca.gov/quality.html>



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2005 Nimbus Road ■ Rancho Cordova, CA 95670
Phone 916/358-2862 ■ Fax 916/985-4301
email: jharring@ospr.dfg.ca.gov
California Aquatic Bioassessment Workgroup homepage: <http://www.dfg.ca.gov/cabw/cabwhome.html>

Program Description

Historically, the use of bioassessment data in California water regulations and decision-making has not been a high priority. California's tremendous range of ecological diversity and its equally complex history of land and water use have confounded progress towards implementation of a state-wide bioassessment program. The recent organization of California's Surface Water Ambient Monitoring Program (SWAMP) is providing the impetus to implement a better organized and standardized biological assessment and monitoring program throughout the state. Current concerns over hydroaugmentation and use attainability analyses of targeted waterbodies will foster a greater dependence upon bioassessment information in making informed decisions regarding the protection and restoration of California's streams.

Nine regional boards are essentially independent regulatory entities within the California State Water Resources Control Board (SWRCB). Not all regional boards are at the same level of development regarding bioassessment. One of the first management actions advancing bioassessment in CA was in 1993 when the Lahontan Regional Water Quality Control Board (RWQCB 6) required the use of EPA's Rapid Bioassessment Protocols in a fish hatchery permit. Since that time, the use of bioassessment in water resource decision-making has steadily increased. Presently, bioassessment is used by several RWQCBs for a variety of purposes, including to: assess the impacts of human activities on the biological integrity of streams and rivers; evaluate the effectiveness of restoration efforts, BMP implementation, and permit conditions; develop narrative and numeric biocriteria; establish reference conditions; provide baseline data on the benthic macroinvertebrate community in regional streams; determine the biological health of streams relative to land use in specific watersheds; help identify aquatic life stressors and associated development of ecological indicators in agriculturally dominated and effluent dominated waterbodies; and as an additional tool to NPDES and stormwater permitting to supplement the chemical and toxicological information obtained to address chemical standards.

The California Department of Fish and Game's (CA DFG) Water Pollution Control Laboratory and its Aquatic Biological Assessment Laboratory (ABAL) perform macroinvertebrate sampling and identification, fish surveys, physical/habitat surveys, toxicity testing, sedimentation studies, and tissue and water chemistry. Since 1992, the ABAL has conducted projects covering many different applications of biological monitoring throughout California. These projects have demonstrated bioassessment and promoted the effectiveness of bioassessment in the State.

In 1993, ABAL distributed a set of standard protocols for assessing biological and physical conditions of Wadeable streams. The California Stream Bioassessment Procedures (CSBP) are regional adaptations of the national USEPA Rapid Bioassessment Protocols. The DFG, in cooperation with the SWRCB and USEPA Region 9, also established the California Aquatic Bioassessment Workgroup (CABW) to provide input and guidance for the development of a state-wide bioassessment program. The Workgroup was formed in 1994 to coordinate scientific and policy-making efforts towards implementing aquatic bioassessment in California. Members of the CABW consist of biologists from universities, consulting firms, industry, and representatives of state and federal agencies responsible for assessing, monitoring and protecting the biological integrity of surface waters. Through its Steering Committee and annual meetings, CABW participants develop objectives and strategies for implementing aquatic bioassessment in California.

Documentation and Further Information

State Water Resources Control Board. October 2000. *2000 California 305(b) Report on Water Quality*. Sacramento, CA: SWRCB.

Status of Aquatic Bioassessment in California and the Development of a State-wide Bioassessment Program, prepared by the California Department of Fish and Game Aquatic Biological Assessment Laboratory: <http://www.dfg.ca.gov/cabw/status.html>

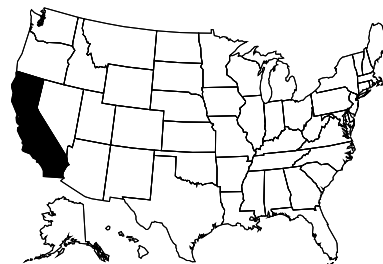
California Stream Bioassessment Procedure (CSBP): <http://www.dfg.ca.gov/cabw/protocols.html>

CALIFORNIA

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email: jharrington@ospr.dfg.ca.gov



Programmatic Elements

Uses of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input checked="" type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input type="checkbox"/>	other:
Applicable monitoring designs	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) (<i>specific river basins or watersheds</i>)
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) (<i>specific river basins or watersheds</i>)
	<input checked="" type="checkbox"/>	probabilistic by stream order/catchment area (<i>specific river basins or watersheds</i>)
	<input checked="" type="checkbox"/>	probabilistic by ecoregion, or statewide (<i>specific river basins or watersheds</i>)
	<input checked="" type="checkbox"/>	rotating basin (<i>comprehensive use throughout jurisdiction</i>)
	<input type="checkbox"/>	other:

Stream Miles

Total miles	211,513
Total perennial miles	64,438
Total miles assessed for biology*	unknown
fully supporting for 305(b)	unknown
partially/non-supporting for 305(b)	unknown
listed for 303(d)	unknown
number of sites sampled	unknown
number of miles assessed per site	unknown

*Due to a comprehensive, statewide overhaul of California's database system, SWRCB was unable to break out numbers for stream miles assessed using biology.

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Fishery Based Uses, Warm Water vs. Cold Water	
ALU designations in state water quality standards	Regional Water Quality Boards have a Basin Planning function. Therefore, water quality standards are regionally specific for establishing functional uses, criteria, and implementation plans.	
Narrative Biocriteria in WQS	Regional water quality standards contain generic statements for the overarching protection of biological communities with an emphasis on, but not limited to, fisheries. Procedures to support narrative biocriteria are regionally specific.	
Numeric Biocriteria in WQS	none	
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input checked="" type="checkbox"/>	permitted discharges
	<input checked="" type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	Limited to select studies where biological data are used for management decisions regarding urban development.	

Reference Site/Condition Development

Number of reference sites	~ 200 - 300 total	
Reference site determinations	<input type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input type="checkbox"/>	regional (aggregate of sites)
	<input checked="" type="checkbox"/>	professional judgment
	<input checked="" type="checkbox"/>	other: CA DFG is in the process of developing a more quantitative method of selecting reference sites on a regional basis using GIS land use analyses and quantitative physical habitat measures.
Reference site criteria	under development	
Characterization of reference sites within a regional context	<input type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Stream stratification within regional reference conditions	<input checked="" type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input checked="" type="checkbox"/>	other: stream order
Additional information	<input type="checkbox"/>	reference sites linked to ALU
	<input checked="" type="checkbox"/>	reference sites/condition referenced in water quality standards (varies by region)
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

Field and Lab Methods

Assemblages assessed	<input checked="" type="checkbox"/>	benthos (>500 samples/year; varying levels of rigor)
	<input type="checkbox"/>	fish
	<input type="checkbox"/>	periphyton
	<input type="checkbox"/>	other:
<hr/>		
Benthos		
sampling gear		D-frame; 200 - 400 micron mesh (Sierra Nevada Aquatic Research Laboratory), 500 - 600 micron mesh (California Stream Bioassessment Procedure)
habitat selection		riffle/run (cobble)
subsample size		300 - 500 count (Sierra Nevada Aquatic Research Laboratory), 300 count (CSBP)
taxonomy		lowest possible, usually genus or species
<hr/>		
Habitat assessments		visual based; performed with bioassessments
<hr/>		
Quality assurance program elements		standard operating procedures, sorting and taxonomic proficiency checks

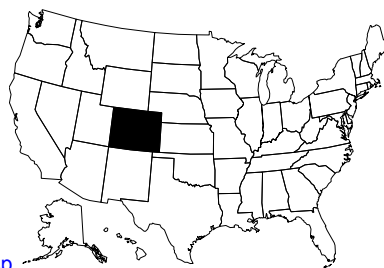
Data Analysis and Interpretation

Data analysis tools and methods	<input type="checkbox"/>	summary tables, illustrative graphs
	<input checked="" type="checkbox"/>	parametric ANOVAs
	<input checked="" type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics (<i>return single metrics – use endpoint for each single metric</i>)
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<hr/>		
Multimetric thresholds		
transforming metrics into unitless scores		bar graph distribution function
<hr/>		
Multivariate thresholds		
defining impairment in a multivariate index		under development
<hr/>		
Evaluation of performance characteristics	<input type="checkbox"/>	repeat sampling
	<input checked="" type="checkbox"/>	precision
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
<hr/>		
Biological data		
Storage		Central Coast Ambient Monitoring Program (CCAMP) regional database
Retrieval and analysis		CalEDAS

COLORADO

Contact Information

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CDPHE Water Quality Control Division website: <http://www.cdphe.state.co.us/wq/wqhom.asp>



Program Description

The Monitoring Unit of the Water Quality Control Division, Colorado Department of Public Health and Environment (CDPHE), is responsible for designing studies and collecting chemical, physical, and biological data from a statewide network of sampling stations. Personnel from the Assessment Unit of the Water Quality Control Division evaluate this information, along with data from other agencies. Using a watershed-specific approach, the seven major watersheds within the State of Colorado are assessed sequentially as part of the triennial review of water quality standards and classifications. In addition, specific waterbodies are assessed as part of targeted synoptic studies, site-specific studies, and as required for evaluating waterbodies listed on the State of Colorado's 303(d) list.

Most biological assessments are performed to evaluate aquatic life use classifications and to support standards development. Biological assessments have occasionally been used to determine attainment of aquatic life uses or attainment of provisional sediment standards. However, chemical information from surface water samples is primarily used to assess use support determinations as reported in the State of Colorado's biennial Status of Water Quality report. Biologists in the Monitoring Unit are actively developing biocriteria to more effectively utilize biological information as part of the State of Colorado's water quality standards program. Initially, biocriteria will be developed for benthic macroinvertebrates. Over the last four years, biologists in the Monitoring Unit have collected benthic macroinvertebrate samples from approximately 300 potential reference/least impaired sites from all dominant ecoregions within the State of Colorado. This data is currently being evaluated. Combined with information on physical habitat and water chemistry, this benthic macroinvertebrate data will be used to develop provisional region-specific biocriteria. Once developed, these provisional biocriteria will be evaluated using new benthic macroinvertebrate information, and further refined as needed. It is anticipated that benthic macroinvertebrate biocriteria will be used as an assessment tool to support the water quality standards and classification programs within the State of Colorado. Biocriteria based on fishery information may be developed in the future.

Documentation and Further Information

Colorado's 2002 305(b) report and 1998 303(d) list: <http://www.cdphe.state.co.us/op/wgcc/wgresdoc.html>

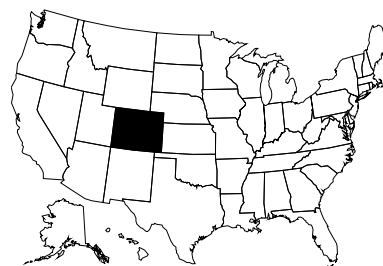
Draft 2001 Unified Assessment Methodology, Guidance on Data Requirements and Data Interpretation Methods Used in Stream Standards and Classification Proceedings, July 1993:
http://www.cdphe.state.co.us/wq/Assessment/assessment_practices_and_methods.htm

Water Quality in Colorado 2000: <http://www.cdphe.state.co.us/wq/waterqualitybooklet.pdf>

COLORADO

Contact Information

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Programmatic Elements

Uses of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input checked="" type="checkbox"/>	other: determine attainment of narrative sediment (clean) standard
Applicable monitoring designs	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) (<i>comprehensive use throughout jurisdiction, specific river basins or watersheds, and special projects</i>)
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) (<i>specific river basins or watersheds</i>)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin (<i>comprehensive use throughout jurisdiction</i>)
	<input type="checkbox"/>	other:

Stream Miles

Total miles	107,403
<i>(determined using RF3)</i>	
Total perennial miles	31,415
Total miles assessed for biology*	n/a
fully supporting for 305(b)	n/a
partially/non-supporting for 305(b)	n/a
listed for 303(d)	85.1
number of sites sampled (<i>on an annual basis</i>)	~70 -100
number of miles assessed per site	—

*Colorado does not use bioassessment in 305(b) assessments with some exceptions. Since Colorado's water quality standards are chemically oriented, the majority of use support determinations are based on chemical data. Bioassessments are conducted as part of the Triennial Standards Review process for Colorado's seven major watersheds; a few are used in the determination of aquatic life use and sediment standards attainment. The majority of CDPHE's work in the field is spent conducting bioassessments in preparation for the review process. During the review process, the Water Quality Control Commission uses biological data to determine the appropriate aquatic life use classification for 636 stream segments. Once classifications are set, all further water quality monitoring and assessment is chemical.

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Class System, Warm Water vs. Cold Water	
ALU designations in state water quality standards	Three classifications: Class 1 Cold Water Aquatic Life, Class 1 Warm Water Aquatic Life, Class 2 Cold and Warm Water Aquatic Life	
Narrative Biocriteria in WQS	under development*	
Numeric Biocriteria in WQS	none*	
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input checked="" type="checkbox"/>	permitted discharges
	<input type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input type="checkbox"/>	watershed based management
Uses of bioassessment/biocriteria uses in making management decisions regarding restoration of aquatic resources to a designated ALU	Bioassessment endpoints are used as targets in the attainment of the sediment standard (e.g. TMDL development).	

*ALU classifications are defined in Colorado's water quality standards but are not considered to be formal narrative biocriteria in the CO regulatory process. Colorado is presently developing biocriteria through a stakeholder workgroup process.

Reference Site/Condition Development**

Number of reference sites	300 total potential reference/least impaired sites	
Reference site determinations	<input checked="" type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input type="checkbox"/>	regional (aggregate of sites)
	<input checked="" type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Reference site criteria	The condition of candidate sites is verified through field evaluation using a "checklist" of stream attributes that include, but are not limited to, measures of riparian condition, Rosgen channel type, land use, basin characteristics, physical habitat, substrate, chemistry, geology, vegetation, and climate.	
Characterization of reference sites within a regional context	<input checked="" type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input checked="" type="checkbox"/>	professional judgment
	<input checked="" type="checkbox"/>	other: minimally disturbed***
Stream stratification within regional reference conditions	<input type="checkbox"/>	UD
	<input type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input checked="" type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
Additional information	<input type="checkbox"/>	other:
	n/a	reference sites linked to ALU
	n/a	reference sites/condition referenced in water quality standards
	n/a	some reference sites represent acceptable human-induced conditions

**Reference condition is used on a limited basis in Colorado. Currently, it is used as a key component in determining sediment deposition impacts to aquatic life and has been used in the first stages of biocriteria development, to locate sampling sites, as part of various EMAP studies underway in CO, and in the development of regional nutrient criteria. The reference condition approach is not developed enough to be an established part of biological assessments or the standards setting process in Colorado. Most, if not all, assessments are conducted on a case-by-case or site-specific basis, and although CO does attempt to characterize the "expected condition" for a particular waterbody, it is not treated as a formal reference condition.

***Sediment guidance suggests 3 tiers for reference conditions like those described in the 1996 EPA technical guidance for biological criteria: 1) minimally disturbed, 2) best available (least disturbed), and 3) none acceptable ("hypothetical explanation"). These can be considered individually and in combination.

Field and Lab Methods*

Assemblages assessed	<input checked="" type="checkbox"/>	benthos (<i>100 - 500 samples/year; single season, multiple sites - watershed level</i>)
	<input checked="" type="checkbox"/>	fish (<i><100 samples/year; single season, multiple sites - not at watershed level</i>)
	UD	periphyton (<i><100 samples/year; single season, multiple sites - watershed level</i>)
	<input type="checkbox"/>	other:
Benthos		
sampling gear		Surber, dipnet; 500 - 600 micron mesh
habitat selection		riffle/run (cobble) or most productive habitat if riffle/run is not available
subsample size		300 count
taxonomy		lowest possible level with positive identification
Fish		
sampling gear		backpack electrofisher
habitat selection		multihabitat
sample processing		length measurement
subsample		none
taxonomy		species
Periphyton		
sampling gear		natural substrate: brushing/scraping device (razor, toothbrush, etc), collect by hand
habitat selection		riffle/run (cobble)
sample processing		chlorophyll <i>a</i> / phaeophytin, taxonomic identification
taxonomy		all algae, species level
Habitat assessments		visual based, hydrogeomorphology, pebble counts; performed with bioassessments
Quality assurance program elements		standard operating procedures, periodic meetings and training for biologists, specimen archival

*Field and lab methods reported are those used by the Monitoring Unit of the CDPHE Water Quality Control Division and are patterned after the EPA RBP approach. They do not apply to any of the other agencies collecting biological data in Colorado.

Data Analysis and Interpretation

Data analysis tools and methods	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics (<i>return single metrics</i>)
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
Multimetric thresholds		
transforming metrics into unitless scores		impairment thresholds determined on case-by-case basis as part of site-specific analyses
defining impairment in a multimetric index		Colorado is currently exploring possible metrics and indices through a workgroup process.
Evaluation of performance characteristics	<input type="checkbox"/>	repeat sampling
	<input checked="" type="checkbox"/>	precision (<i>replicate samples collected at 10% of sites</i>)
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
Biological data		
Storage		Currently moving all biological and habitat data into EDAS
Retrieval and analysis		EDAS, Excel, Minitab

CONNECTICUT

Contact Information

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Program Description

The Connecticut Ambient Biological Monitoring Program characterizes water quality by evaluating the biological integrity of resident communities of aquatic organisms. This information is used as the primary indicator to meet reporting requirements for assessment of aquatic life use support and impairment under Sections 305(b) and 303(d) of the Clean Water Act. There are currently about 3.5 full time employees dedicated to biological assessment of rivers. Biological monitoring has been conducted by the CT DEP Bureau of Water Management since the early 1970s and has focused primarily on the benthic invertebrate community of Wadeable stream segments. Narrative criteria for benthic invertebrates were incorporated into the CT water quality standards in 1987. Assessments are based on community structure characteristics using techniques intended to minimize the influence of variables such as habitat, seasonality and sampling method. Since 1989, methodology has followed a modified version of the USEPA Rapid Bioassessment Protocol (RBP) III (USEPA 1989).

A total of 302 sites on 153 rivers have been monitored to date (February 2002). Pursuant to the five-year rotating basin monitoring strategy that began in 1996, benthic invertebrate monitoring was conducted at approximately 50 sites each year for the five-year period ending in 2000. Since biological monitoring integrates environmental conditions over an extended time period, each site was sampled only once, primarily during the fall. Spring sampling is conducted on a limited basis for special studies or to supplement fall sampling. Sampling site selection is based on a targeted approach that considers sub-basin size, location of wastewater discharges, land use, and resource value. In addition to the rotating basin schedule, approximately ten regional reference sites located across the State are sampled annually, as well as a limited number of sites to support special projects.

The Bureau of Water Management recognizes the need to obtain a broader perspective of biological integrity by incorporation of fish community assessment data into the biological monitoring process. This has been accomplished to a limited degree by a cooperative working relationship with the CT DEP Division of Inland Fisheries. Fish sampling information obtained by fisheries biologists for purposes consistent with the fisheries management program has been utilized in the form of best professional judgment assessments which CT DEP considers to be generally equivalent to USEPA RBP IV (USEPA 1989). Funds obtained through an EPA 104(b)(3) grant have supported part of a Fisheries Division staff position since 1999. This effort has provided for approximately 24 fish community surveys, roughly equivalent in effort to annual RBP V assessment. This project is intended to support development of fish community structure metrics that will provide a more quantitative approach to the assessment process.

The CT DEP also promotes and directs a monitoring program for volunteers from which usable assessment information is obtained. The details of this program, *A Tiered Approach to Citizen-Based Monitoring of Wadeable Streams and Rivers*, can be obtained from the CT DEP Bureau of Water Management or viewed online at <http://dep.state.ct.us/wtr/volunmon/tierapp.pdf>

Section 305(b) of the CWA requires that states provide a description of the water quality of all navigable waters within their boundaries. Even with program improvements resulting from the rotating basin approach and incorporation of volunteer data, a complete census of State waters is not possible based on this focused approach to monitoring. To accomplish the goal of comprehensive monitoring, CT DEP is currently utilizing funds and technical assistance from USEPA to conduct a pilot statewide probabilistic monitoring program during 2002-2003. This project will sample the benthic invertebrate, fish, and periphyton communities at approximately 60 randomly selected sites. Through probabilistic monitoring, this statistically valid sample of Wadeable streams in Connecticut will provide an estimate of conditions of all Wadeable streams in the State. During this two-year period, the rotating basin approach will be suspended. However, limited focused monitoring will continue for reference sites, special projects, intensive surveys and to support TMDL development.

Documentation and Further Information

DRAFT 2002 List of Connecticut Waterbodies Not Meeting Water Quality Standards, 303(d) list, May 2002:
<http://dep.state.ct.us/wtr/wq/implist.pdf>

Draft Consolidated Assessment and Listing Methodology for 305(b) and 303(d) Reporting, April 2002:
<http://dep.state.ct.us/wtr/wq/method.pdf>

Quality Assurance Project Plan for Ambient Biological Monitoring, March 1996. CT DEP Bureau of Water Management, Planning and Standards Division, CT06106.

Beauchene, M. 2002. *Quality Assurance Project Plan, Ambient Biological Monitoring -- Fish Community Structure*. CT DEP Bureau of Water Management.

Ambient Monitoring Strategy for Rivers and Streams, Rotating Basin Approach. CT DEP 1999.

CONNECTICUT

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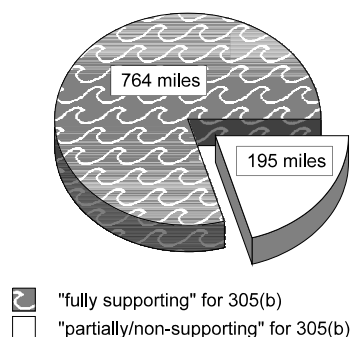
Programmatic Elements

Uses of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input checked="" type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input type="checkbox"/>	other:
Applicable monitoring designs	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) (<i>special projects, specific river basins and watersheds, and comprehensive use throughout jurisdiction</i>)
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) (<i>special projects, specific river basins and watersheds, and comprehensive use throughout jurisdiction</i>)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input checked="" type="checkbox"/>	probabilistic by ecoregion, or statewide (<i>comprehensive use throughout jurisdiction beginning in 2002 and 2003</i>)
	<input checked="" type="checkbox"/>	rotating basin (<i>comprehensive use throughout jurisdiction</i>)
	<input type="checkbox"/>	other:

Stream Miles

Total miles	5,830
<i>(State based determinations)</i>	
Total perennial miles	5,484
Total miles assessed for biology	961
fully supporting for 305(b)	764
partially/non-supporting for 305(b)	195
listed for 303(d)*	n/a
number of sites sampled*	311
number of miles assessed per site*	site specific

961 Miles Assessed for Biology



*The existing 303(d) doesn't use mileage, although it contains a subset of partially/non-supporting stream miles listed in the 305(b). These numbers will be the same in the next report. Of the 311 sites sampled, 221 were sampled by the state, 30 by contractors and 60 by volunteers. The number of miles assessed per site is site specific and varies according to land use, geomorphology, etc.

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Class System (A,B,C)	
ALU designations in state water quality standards	"Fish and Wildlife Habitat" is the only ALU designation, but narrative criteria are provided for "benthic invertebrates which inhabit lotic waters" for classifications AA, A, and B while more general descriptive narrative is provided for C and D.	
Narrative Biocriteria in WQS	Procedures used to support narrative biocriteria located in <i>SOPs for ambient biological monitoring</i>	
Numeric Biocriteria in WQS	none	
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input checked="" type="checkbox"/>	permitted discharges
	<input checked="" type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	Bioassessment/biocriteria have been used in specific cases to determine if formerly impaired waters are meeting ALU.	

Reference Site/Condition Development

Number of reference sites	12 total	
Reference site determinations	<input checked="" type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input type="checkbox"/>	regional (aggregate of sites)
	<input type="checkbox"/>	professional judgment
	<input checked="" type="checkbox"/>	other: within major drainage basin
Reference site criteria	Least impacted by human influence. Size: \pm one stream order or one order of magnitude in drainage area with similar gradient.	
Characterization of reference sites within a regional context	<input type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Stream stratification within regional reference conditions	<input type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input checked="" type="checkbox"/>	other: major drainage basin, gradient
Additional information	<input type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

Field and Lab Methods

Assemblages assessed	<input checked="" type="checkbox"/>	benthos (<100 samples/year; single season, multiple sites - watershed level; multiple seasons, multiple sites - broad coverage for watershed level)
	<input checked="" type="checkbox"/>	fish (<100 samples/year; single season, multiple sites - broad coverage)
	<input checked="" type="checkbox"/>	periphyton (<100 samples/year; single season, multiple sites - broad coverage)
	<input checked="" type="checkbox"/>	other: phytoplankton and macrophytes (<100 sample/year; single season, multiple sites - not at watershed level)
Benthos		
sampling gear		Rectangular kick net, 1.5 ft. wide, 800-900 micron mesh. Surber and multiple plate samplers used prior to 1989. Rock baskets used for special projects.
habitat selection		richest habitat, riffle/run (cobble)
subsample size		200 count
taxonomy		benthic identification is primarily to species
Fish		
sampling gear		backpack electrofisher, pram unit (tote barge)
habitat selection		multihabitat
sample processing		length measurement, anomalies
subsample		none
taxonomy		species
Periphyton		
sampling gear		natural substrate: brushing/scraping device (razor, toothbrush, etc.)
habitat selection		riffle/run (cobble)
sample processing		chlorophyll <i>a</i> / phaeophytin; biomass; taxonomic identification; semi-quantitative field-based rapid periphyton survey
taxonomy		all algae, species level if possible
Habitat assessments		visual based; performed with bioassessments
Quality assurance program elements		standard operating procedures, quality assurance plan, periodic meetings and training for biologists, sorting and taxonomic proficiency checks, specimen archival

Data Analysis and Interpretation

Data analysis tools and methods	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics (<i>aggregate metrics into an index</i>)
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
Multimetric thresholds		
transforming metrics into unitless scores		Use scoring criteria table from 1989 Rapid Bioassessment Protocol (RBP) guidance (Figure 6.3-4). CT DEP recognizes the need to refine scoring criteria and impairment thresholds.
defining impairment in a multimetric index		Use biological condition table from 1989 RBP guidance (Figure 6.3-4): >54% of reference score = non-impaired for purposes of 305(b)/303(d)
Evaluation of performance characteristics	<input checked="" type="checkbox"/>	repeat sampling (<i>duplicate samples at reference sites</i>)
	<input type="checkbox"/>	precision
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
Biological data		
Storage		Initial sample data is entered into an Excel spreadsheet then transferred to MS Access. Currently working on migration from MS Access to STORET.
Retrieval and analysis		Spreadsheet used for metric calculation. Formerly used SAS. Currently shopping for less expensive statistical package.

DELAWARE

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<http://www.dnrec.state.de.us/dnrec2000/Divisions/Water/WaterQuality/WQM.htm>



Program Description

Water quality and biological data for Delaware's surface waters are collected under Delaware's Ambient Surface Water Quality Monitoring Program and Biological Monitoring Program within the Delaware Department of Natural Resources and Environmental Control (DNREC). Several active citizen monitoring programs have also been developed throughout Delaware that augment the data collected by DNREC. The purpose of the Ambient Surface Water Quality Monitoring Program is to collect data on the chemical, physical, and biological characteristics of Delaware's surface waters. The information collected under this program is used to:

- Describe general water quality conditions in the State;
- Identify long-term trends in water quality;
- Determine the suitability of Delaware's waters for water supply, recreation, fish and aquatic life, and other uses;
- Monitor achievement of water quality standards;
- Identify and prioritize high quality and degraded waters;
- Support Total Maximum Daily Load Program; and
- Evaluate the overall success of Delaware's water quality management efforts.

DNREC recognizes the need to use its personnel and financial resources efficiently and effectively. To that end, surface water quality monitoring is conducted in a manner that focuses available resources on the Whole Basin Management concept. This program calls for the Department, in partnership with other governmental entities, private interests, and all stakeholders, to focus its resources on specific watersheds and basins (groups of watersheds) within specific time frames. The Whole Basin Management Program in Delaware operates on a 5-year rotating basis. In addition to the planning and preliminary assessment steps, Whole Basin Management will include intensive basin monitoring, comprehensive analyses, management option evaluations, and resource protection strategy development. Public participation and ongoing implementation activities will occur throughout the Whole Basin Management process. This new approach enables DNREC to comprehensively monitor and assess the condition of the State's environment with due consideration to all facets of the ecosystem.

Biological assessment monitoring is one of five major components of Delaware's Surface Water Quality Monitoring Program. The biological monitoring program is a major tool used by the Department to assess the conditions of surface waters. It includes the assessment of indigenous biological communities and physical habitats of streams, ponds, estuaries and wetlands. The goal of the program is to establish numeric biological criteria in State water quality standards to complement both existing chemical criteria and other assessments focused on fish tissue monitoring and bioassay testing. Standard methods have been developed and tested for assessing the biological community and habitat quality of nontidal streams, and draft numeric criteria are under development. Efforts over the next few years will focus on the development of methods for assessing estuaries and ponds and for assessing the quality and quantity of wetlands.

Documentation and Further Information

State of Delaware 2000 Watershed Assessment 305(b) Report and 1998 303(d) List:
<http://www.dnrec.state.de.us/water2000/Sections/Watershed/TMDL/305and303.htm>

DE Surface Water Quality Standards: <http://www.dnrec.state.de.us/water/wqs1999.pdf>

State of Delaware Fiscal Year 2000 Surface Water Quality Monitoring Plan:
<http://www.dnrec.state.de.us/dnrec2000/Library/Water/swmonpro.pdf>

Division of Water Resources 2000 Annual Report: <http://www.dnrec.state.de.us/water2000/Public/2000AnnualReport/index.htm>

DELAWARE

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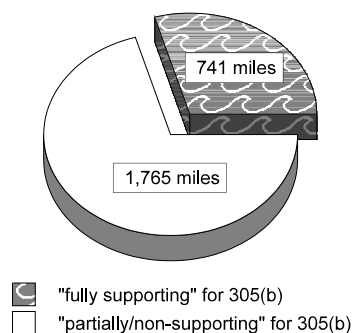
Programmatic Elements

Uses of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	<input type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input type="checkbox"/>	ALU determinations/ambient monitoring
	<input type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
Applicable monitoring designs	<input type="checkbox"/>	other:
	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) (<i>special projects only</i>)
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) (<i>specific riverbasins or watersheds</i>)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin
	<input checked="" type="checkbox"/>	other: probabilistic by specific county (<i>used comprehensively throughout state</i>)

Stream Miles

Total miles (determined using RF3)	2,506
Total perennial miles	1,778
Total miles assessed for biology*	2,506
fully supporting for 305(b)*	741
partially/non-supporting for 305(b)*	1,765
listed for 303(d)*	1,173
number of sites sampled (1991 - 2001)**	195
number of miles assessed per site	—

2,506 Miles Assessed for Biology



*All of DE's streams were assessed for the 2000 305(b) Report. These numbers represent the miles assessed for aquatic life support using a combination of physical, chemical, and biological data.

**These sampling stations were EMAP based. Of the 195 total sites sampled, 49 sites have not yet been assessed. Of the 146 sites assessed, 27 are fully supporting and 119 are partially/non-supporting.

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Single Aquatic Life Use and Warm Water vs. Cold Water	
ALU designations in state water quality standards	Two designations: 1) Fish, Aquatic Life, and Wildlife; 2) Cold Water Fish	
Narrative Biocriteria in WQS	none - Procedures used to support general aquatic life statements in WQS are those developed by the Mid Atlantic Coastal Streams (MACS) Workgroup.	
Numeric Biocriteria in WQS	Draft numeric criteria are under development.	
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input type="checkbox"/>	cause and effect determinations
	<input type="checkbox"/>	permitted discharges
	<input type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input type="checkbox"/>	watershed based management
Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	Some streams have been placed on the State's 303(d) list for poor biology/habitat.	

Reference Site/Condition Development

Number of reference sites	13 total	
Reference site determinations	<input type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input checked="" type="checkbox"/>	regional (aggregate of sites)
	<input checked="" type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Reference site criteria	Least impacted, land use, habitat score >110 out of 140, no point source discharge, no known direct discharge from animal feedlots or urban runoff, professional judgment.	
Characterization of reference sites within a regional context	<input type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Stream stratification within regional reference conditions	<input checked="" type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input type="checkbox"/>	other:
Additional information	<input type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

Field and Lab Methods

Assemblages assessed	<input checked="" type="checkbox"/>	benthos (<100 samples/year; single season, multiple sites - broad coverage)
	<input type="checkbox"/>	fish
	<input type="checkbox"/>	periphyton
	<input type="checkbox"/>	other:
<hr/>		
Benthos		
sampling gear		D-frame and kick net (1 meter); 500-600 micron mesh
habitat selection		riffle/run (cobble) in Piedmont ecoregion, and multihabitat in Coastal Plain ecoregion
subsample size		200 count
taxonomy		genus
<hr/>		
Habitat assessments		visual based; performed with bioassessments
<hr/>		
Quality assurance program elements		standard operating procedures, periodic meetings and training for biologists, sorting proficiency checks, specimen archival, and a QAPP for biological work is under development

Data Analysis and Interpretation

Data analysis tools and methods	<input type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics (<i>aggregate metrics into an index</i>)
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
<hr/>		
Multimetric thresholds		
transforming metrics into unitless scores		95 th percentile of all sites
defining impairment in a multimetric index		< 67% of reference is impaired to some degree
<hr/>		
Evaluation of performance characteristics	<input checked="" type="checkbox"/>	repeat sampling (<i>replicate samples are collected at every 10 sites by the same team, at the same reach or an adjacent reach</i>)
	<input type="checkbox"/>	precision
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
<hr/>		
Biological data		
Storage		MS Access and Excel
Retrieval and analysis		Excel

DISTRICT OF COLUMBIA

Contact Information

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DOH Water Quality Division homepage:

http://dchealth.dc.gov/services/administration_offices/environmental/services2/water_division/index.shtm



Program Description

The mission of DC's Department of Health (DC DOH), Environmental Health Administration, Water Quality Division is to restore and protect the surface and ground waters of the District of Columbia. The program, established under the authorities of the DC Water Pollution Control Act and the federal Clean Water Act (CWA), has three principal components:

Water Quality Control

The Water Quality Control component fulfills the function of policy planning as well as regulatory control. In addition, it conducts special studies on pollutant fate and transport to identify probable sources and impacts, river/stream sediment and water column quality not covered by ambient monitoring, wet weather nonpoint source runoff quantity and quality, and discharge-related facility inspections. It also tracks permit violations.

Water Quality Monitoring

Water Quality Monitoring functions encompass waterbody assessment; collection of ambient water quality data; periodic fish tissue analysis for parameters of concern such as PCB, chlordane, and DDT; periodic submerged aquatic vegetation survey; and bioassessment of wetlands and river fringes.

Environmental Laboratory

The Environmental Laboratory is charged with the analysis of samples for a variety of chemical parameters.

Documentation and Further Information

District of Columbia 2000 305(b) Report, Executive Summary:

http://dchealth.dc.gov/services/administration_offices/environmental/services2/water_division/pdf/00-305bexsumm.shtm

District of Columbia Water Quality Standards:

http://dchealth.dc.gov/services/administration_offices/environmental/services2/water_division/pdf/WaterQualityStandards.shtm

District of Columbia Water Quality Monitoring Regulations (Chapter 19 of DC Municipal Regulations):

http://dchealth.dc.gov/services/administration_offices/environmental/services2/water_division/pdf/WaterQualityMonitoring.shtm

DISTRICT OF COLUMBIA

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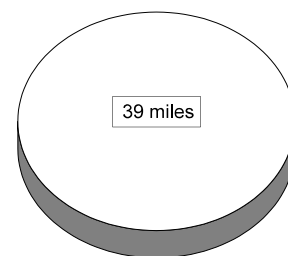
Programmatic Elements

Uses of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	<input type="checkbox"/>	nonpoint source assessments
	<input type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
Applicable monitoring designs	<input type="checkbox"/>	other:
	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) (<i>special projects only</i>)
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) (<i>comprehensive use throughout jurisdiction</i>)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input type="checkbox"/>	rotating basin
	<input type="checkbox"/>	other:

Stream Miles

Total miles	39
<i>(determined using state based GIS coverage)</i>	
Total perennial miles	—
Total miles assessed for biology	39
fully supporting for 305(b)	0
partially/non-supporting for 305(b)	39
listed for 303(d)	unknown
number of sites sampled	unknown
number of miles assessed per site	unknown

39 Miles Assessed for Biology



- ☒ "fully supporting" for 305(b)
- ☐ "partially/non-supporting" for 305(b)

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Single Aquatic Life Use
ALU designations in state water quality standards	One designation: Protection and propagation of fish, shellfish and wildlife
Narrative Biocriteria in WQS	Formal/informal numeric procedures are used to support narrative biocriteria
Numeric Biocriteria in WQS	none
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input type="checkbox"/> assessment of aquatic resources
	<input type="checkbox"/> cause and effect determinations
	<input type="checkbox"/> permitted discharges
	<input type="checkbox"/> monitoring (e.g., improvements after mitigation)
	<input type="checkbox"/> watershed based management
Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	unknown

Reference Site/Condition Development

Number of reference sites	2 total
Reference site determinations	<input type="checkbox"/> site-specific
	<input type="checkbox"/> paired watershed
	<input type="checkbox"/> regional (aggregate of sites)
	<input checked="" type="checkbox"/> professional judgment
	<input type="checkbox"/> other:
Reference site criteria	DC DOH does not have reference site criteria. All streams in DC are contaminated. DC DOH compares streams to reference streams in Prince Georges and Montgomery Counties in Maryland.
Characterization of reference sites within a regional context <i>Information not provided</i>	<input type="checkbox"/> historical conditions
	<input type="checkbox"/> least disturbed sites
	<input type="checkbox"/> gradient response
	<input type="checkbox"/> professional judgment
	<input type="checkbox"/> other:
Stream stratification within regional reference conditions	<input type="checkbox"/> ecoregions (or some aggregate)
	<input type="checkbox"/> elevation
	<input type="checkbox"/> stream type
	<input type="checkbox"/> multivariate grouping
	<input checked="" type="checkbox"/> jurisdictional (i.e., statewide)
Additional information	<input type="checkbox"/> reference sites linked to ALU
	<input type="checkbox"/> reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/> some reference sites represent acceptable human-induced conditions

Field and Lab Methods

Assemblages assessed	<input checked="" type="checkbox"/>	benthos (<100 samples/year; single observation, limited sampling)
	<input checked="" type="checkbox"/>	fish (<100 samples/year; single observation, limited sampling)
	<input type="checkbox"/>	periphyton
	<input checked="" type="checkbox"/>	other: phytoplankton and zooplankton (<100 samples/year; single observation, limited sampling)
Benthos		
sampling gear	D-frame, kick net (1 meter); mesh size information not provided	
habitat selection	riffle/run (cobble)	
subsample size	100 count	
taxonomy	family	
Fish		
sampling gear	backpack electrofisher	
habitat selection	pool/glide, riffle/run (cobble)	
sample processing	length measurement, biomass – individual	
subsample	none	
taxonomy	species	
Habitat assessments	hydrogeomorphology; performed with bioassessments	
Quality assurance program elements	standard operating procedures, quality assurance plan, periodic meetings and training for biologists	

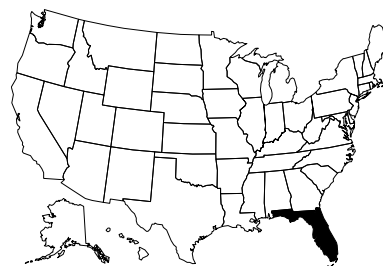
Data Analysis and Interpretation

Data analysis tools and methods	<input type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
Multimetric thresholds		
transforming metrics into unitless scores	<i>Information not provided</i>	
defining impairment in a multimetric index	<i>Information not provided</i>	
Multivariate thresholds		
defining impairment in a multivariate index	<i>Information not provided</i>	
Evaluation of performance characteristics <i>Information not provided</i>	<input type="checkbox"/>	repeat sampling
	<input type="checkbox"/>	precision
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
Biological data		
Storage	paper files only	
Retrieval and analysis	data retrieved from paper files	

FLORIDA

Contact Information

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FDEP Bioassessment homepage: <http://www.dep.state.fl.us/water/bioassess/index.htm>



Program Description

Biological sampling has been one component of the Florida Department of Environmental Protection's (FDEP) overall monitoring strategy since the early 1970s. The Bioassessment Program, in its current manifestation, has been in existence since 1992, in response to the need for tools that would detect and characterize the nature and extent of nonpoint source pollution (*sensu* the 319 program). The primary goal of FDEP's bioassessment activities are to determine the biological health, or degree of impairment, in the State's surface waters. The biological assessment results are heavily utilized by a number of FDEP programs for making informed environmental decisions:

- Total Maximum Daily Load (303(d)) program – determining the impairment status of waterbodies for potential inclusion on the 303(d) list
- The National Pollutant Discharge Elimination System (NPDES) program – determining effectiveness of discharge permit limits
- Nonpoint Source Program – targeting areas with nonpoint source problems and determining the effectiveness of Best Management Practices
- Rotating Basin Assessment program – overall assessment of all human activities in a watershed
- Mine Reclamation program – determining the success of mitigation efforts
- FDEP's Division of Waste Management – ensuring that clean up efforts are sufficient to protect aquatic life adjacent to waste clean up sites (e.g., RCRA).

Biological data are used in Florida's 305(b) report as one of the key pieces of Aquatic Life Use Support (ALUS) information for determining if a waterbody meets its designated use. Bioassessment data are also used for establishing the impairment status of a waterbody for 303(d) listing purposes.

After recalibration of bioassessment metrics and indices (currently underway), it is anticipated that Florida's water quality standards (Rule 62.302 Florida Administrative Code) will be revised accordingly. Although the primary target community for the bioassessment program is currently benthic macroinvertebrates, Florida is also working on potential assessment methods that use algal and vascular plant assemblages. While multimetric biological indices are currently complete for streams, rivers, and lakes, it is anticipated that ongoing index development for wetlands and estuaries will be finalized over the next several years.

The most important recent accomplishment of the Bioassessment Program has been the inclusion of the Stream Condition Index, the BioRecon, and Lake Condition Index as impairment indicator tools in Florida's Impaired Waters Rule (IWR), Rule 62-303, FAC. The IWR is a new administrative code that provides detailed specifications for how surface waters are determined to be impaired for Section 303(d) listing. Future challenges include incorporating the bioassessment tools into a Statewide probabilistic survey design, as well as continuing to meet the increasing demands for biological tools and data.

Documentation and Further Information

2000 Florida Water Quality Assessment 305(b) Report: <http://www.dep.state.fl.us/water/305b/index.htm>

Numerous technical reports are available online at <http://www.dep.state.fl.us/labs/reports/index.htm> and <http://www.dep.state.fl.us/water/bioassess/pubs.htm>

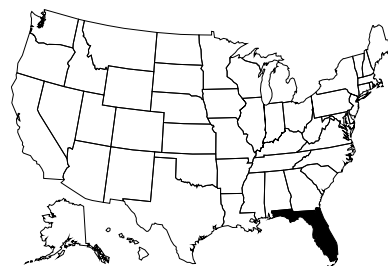
For an online collection of FDEP standard operating procedures, go to: <http://www.dep.state.fl.us/labs/qa/sops.htm>

Surface Water Quality Classifications: <http://www.dep.state.fl.us/water/surfacewater/index.htm>

FLORIDA

Contact Information

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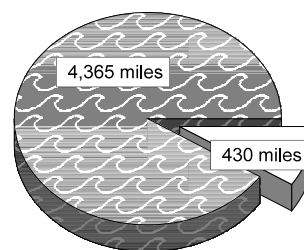
Programmatic Elements

Uses of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input checked="" type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input checked="" type="checkbox"/>	other: biocriteria development
Applicable monitoring designs	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) <i>(comprehensive use throughout jurisdiction)</i>
	<input type="checkbox"/>	fixed station (i.e., water quality monitoring stations)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin (5-year rotation, comprehensive use throughout jurisdiction)
	<input type="checkbox"/>	other:

Stream Miles

Total miles <i>(determined using waterbody identification- segment of stream, generally 5 mile increments)</i>	51,858
Total perennial miles	22,993
Total miles assessed for biology	4,795
fully supporting for 305(b)	4,365
partially/non-supporting for 305(b)	430
listed for 303(d)	430
number of sites sampled (over 2 years)	959
number of miles assessed per site	5

4,795 Miles Assessed for Biology



- ☒ "fully supporting" for 305(b)
- ☐ "partially/non-supporting" for 305(b)

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Single aquatic life use
ALU designations in state water quality standards	One designation: propagation of a healthy, well balanced fish and wildlife community
Narrative Biocriteria in WQS	Procedures used to support narrative biocriteria located in FDEP's Standard Operating Procedures
Numeric Biocriteria in WQS	Numeric biocriteria located in Rule 62-302 Florida Administrative Code – "Shannon-Weaver diversity shall not be reduced more than 25% of background conditions" *
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/> assessment of aquatic resources <input checked="" type="checkbox"/> cause and effect determinations <input checked="" type="checkbox"/> permitted discharges <input checked="" type="checkbox"/> monitoring (e.g., improvements after mitigation) <input checked="" type="checkbox"/> watershed based management
Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	TMDLs, restoration/mitigation studies, BMP effectiveness studies, discharge permit renewal

*Florida has made substantial progress in developing new multimetric indices for streams (Stream Condition Index and BioRecon), lakes (Lake Condition Index), and wetlands for eventual inclusion in the Florida Administrative Code. When the new indices are adopted as water quality standards, the role of Shannon-Weaver diversity as a numeric standard will be re-evaluated.

Reference Site/Condition Development

Number of reference sites	150 total
Reference site determinations	<input type="checkbox"/> site-specific <input type="checkbox"/> paired watersheds <input checked="" type="checkbox"/> regional (aggregate of sites) <input checked="" type="checkbox"/> professional judgment <input type="checkbox"/> other:
Reference site criteria	least impaired by human activities in a region, optimal habitat, benign land use in watershed, uncontaminated water quality, undisturbed hydrology
Characterization of reference sites within a regional context	<input type="checkbox"/> historical conditions <input checked="" type="checkbox"/> least disturbed sites <input checked="" type="checkbox"/> gradient response (<i>for recalibration of existing indexes</i>) <input type="checkbox"/> professional judgment <input type="checkbox"/> other:
Stream stratification within regional reference conditions	<input checked="" type="checkbox"/> ecoregions (or some aggregate) <input type="checkbox"/> elevation <input type="checkbox"/> stream type <input type="checkbox"/> multivariate grouping <input type="checkbox"/> jurisdictional (i.e., statewide) <input type="checkbox"/> other:
Additional information	<input type="checkbox"/> reference sites linked to ALU <input type="checkbox"/> reference sites/condition referenced in water quality standards <input checked="" type="checkbox"/> some reference sites represent acceptable human-induced conditions

Field and Lab Methods

Assemblages assessed	<input checked="" type="checkbox"/>	benthos (100-500 samples/year; single season, multiple sites - watershed level)
	<input type="checkbox"/>	fish
	<input checked="" type="checkbox"/>	periphyton (100-500 samples/year; single season, multiple sites - not at watershed level)
	<input checked="" type="checkbox"/>	other: phytoplankton, macrophytes (100-500 samples/year; single observation, limited sampling)
Benthos		
sampling gear		d-frame, dipnet (500-600 micron mesh), multiplate (Hester-Dendys)
habitat selection		multihabitat (snags, roots, leaf packs, aquatic vegetation)
subsample size		100-count target
taxonomy		species level (where possible)
Periphyton		
sampling gear		natural substrate: brushing/scraping device (razor, toothbrush, etc.), collect by hand artificial substrate: periphytometer, microslides or other suitable substratum
habitat selection		multihabitat
sample processing		chlorophyll <i>a</i> /phaeophytin, taxonomic identification
taxonomy		all algae, species level (diatoms to variety level)
Habitat assessments		visual based; performed with bioassessments
Quality assurance program elements		standard operating procedures, quality assurance plan, periodic meetings and training for biologists, sorting and taxonomic proficiency checks, specimen archival, habitat assessment tests, sampling field audits, sampling variability studies, performance testing program for bioassessment

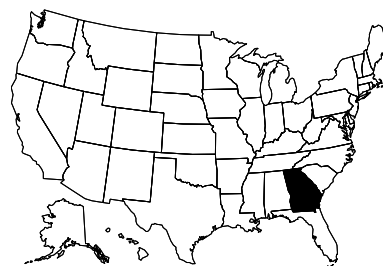
Data Analysis and Interpretation

Data analysis tools and methods	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics (<i>aggregate metrics into an index</i>)
	<input checked="" type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
Multimetric thresholds		
transforming metrics into unitless scores		25 th percentile of reference population
defining impairment in a multimetric index		quadrisection of best score
Evaluation of performance characteristics	<input checked="" type="checkbox"/>	repeat sampling (<i>same team, same reach; different teams in same reach</i>)
	<input checked="" type="checkbox"/>	precision (<i>coefficient of variation</i>)
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input checked="" type="checkbox"/>	accuracy (<i>species accumulation</i>)
Biological data		
Storage		custom Oracle-based program, "S-BIO"
Retrieval and analysis		custom Oracle-based program, "S-BIO"

GEORGIA

Contact Information

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GA DNR Environmental Protection Division: <http://www.dnr.state.ga.us/dnr/environ/>



Program Description

The Georgia Department of Natural Resources (GA DNR) Environmental Protection Division (EPD) monitoring program integrates physical, chemical, and biological monitoring to provide information for water quality, use attainment assessments, and basin planning. EPD monitors the surface waters of the state to collect baseline and trend data, document existing conditions, study impacts of specific discharges, determine improvements resulting from upgraded water pollution control plants, support enforcement actions, establish wasteload allocations for new and existing facilities, verify water pollution control plant compliance, document water use impairment and reasons for problems causing less than full support of designated water uses, and develop TMDLs. Intensive surveys; lake, coastal, biological, fish tissue, toxic substance, and trend monitoring; and facility compliance sampling are the major monitoring tools used by EPD.

Long-term, trend, and ambient monitoring of streams at strategic locations throughout Georgia, was initiated by EPD during the late 1960s. This work was and continues to be accomplished to a large extent through cooperative agreements with federal, state, and local agencies who collect samples from groups of stations at specific, fixed locations throughout the year.

In 1995, EPD adopted and implemented significant changes to the strategy for trend monitoring in Georgia. The changes were implemented to support the River Basin Management Planning program. The number of fixed stations statewide was reduced in order to focus resources for sampling and analysis in a particular group of basins in any one year in accordance with the basin planning schedule. This approach provides the framework for identifying, assessing, and prioritizing water resource issues, developing implementation strategies, and providing opportunities for targeted, cooperative actions to reduce pollution, enhance aquatic habitat, and provide a dependable water supply.

The Watershed Planning and Monitoring Section of the EPD Water Protection Branch performs the following tasks:

- Conducts monitoring of Georgia streams, rivers, lakes and estuaries for use with wasteload allocations and to determine compliance with water quality standards;
- Develops River Basin Management Plans for river basins in Georgia;
- Conducts water quality modeling for wasteload allocations, water use classifications, and water quality standards in Georgia; and
- Collects samples of facility discharges for laboratory testing of samples.

Currently, reference site selection and biocriteria development are being carried out under contract with Columbus State University. The project is in Phase III with projected completion in 2003. The final phase, Phase IV, is projected to be completed in 2004.

Documentation and Further Information

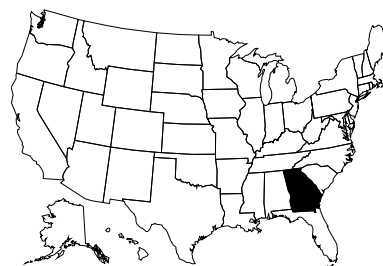
Georgia's 2000 305(b) Report, *Water Quality in Georgia, 1998-1999*; the *Final Georgia 2000 305(b)/303(d) List Documents*, including *Summary of Changes from the 2000 to 2002 305(b)/303(d) List*, can be found under Georgia's Environment, Water Quality in the Table of Contents at the following site:
<http://www.dnr.state.ga.us/dnr/environ/>

2000. DRAFT *Standard Operating Procedures for Freshwater Macroinvertebrate Biological Assessment*. Georgia Department of Natural Resources, Water Protection Branch, Atlanta, GA.

GEORGIA

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 email: kathy_methier@dnr.state.ga.us



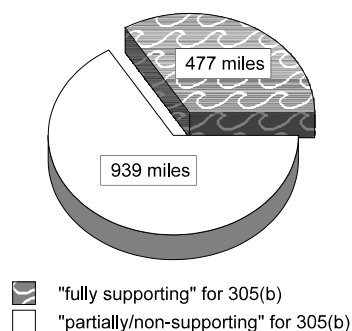
Programmatic Elements

Uses of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input checked="" type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
Applicable monitoring designs	<input type="checkbox"/>	other:
	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) <i>(specific river basins or watersheds)</i>
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) <i>(specific river basins or watersheds, and comprehensive use throughout jurisdiction)</i>
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin <i>(comprehensive use throughout jurisdiction)</i>
	<input type="checkbox"/>	other:

Stream Miles

Total miles <i>(determined using state based coverage)</i>	70,150
Total perennial miles	44,056
Total miles assessed for biology*	1,416
fully supporting for 305(b)	477
partially/non-supporting for 305(b)	939
listed for 303(d)	—
number of sites sampled <i>(in 2000)</i>	153
number of miles assessed per site	varies

1,416 Miles Assessed for Biology



*In 2000, 72 stations were sampled and a total of 477 miles were assessed as fully supporting for 305(b) (6.6 miles assessed/station); 75 stations were sampled and a total of 799 miles were assessed as partially supporting (10.7 miles assessed/station); 6 stations were sampled and 140 miles were assessed as not supporting (23.3 miles assessed/station). This results in a total of 153 stations and 1,416 stream miles assessed in 2000 (9.25 miles assessed/station). The stream miles listed above are not divided into those monitored for biology versus chemistry because 305(b) reporting requirements use both types of data. The sampling length per site varies and the length of stream represented by each sample is determined by the surrounding hydrography.

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Fishery Based Uses	
ALU designations in state water quality standards	Three designations: Coastal fishing; fishing, propagation of fish, shellfish, game, and other aquatic life; primary and secondary trout waters	
Narrative Biocriteria in WQS	Procedures used to support narrative biocriteria are located in the Environmental Protection Division's SOPs for macroinvertebrates and DNR/Wildlife Resources Division's IBI protocols for fish	
Numeric Biocriteria in WQS	none	
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input checked="" type="checkbox"/>	permitted discharges
	<input checked="" type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	Fish IBI and macroinvertebrate assessments were conducted to evaluate approximately 80 previously 303(d)-listed sites in the last two years. While some sites were removed from the list others, found to be impaired due to (clean) sediment deposition, remained on the list.	

Reference Site/Condition Development

Number of reference sites	Reference site selection is under development.	
Reference site determinations	<input type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input checked="" type="checkbox"/>	regional (aggregate of sites)
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Reference site criteria	Columbus State University is using several criteria for selecting reference sites, including minimum overall habitat score, managed land, urban land, minimum forested riparian zone width, forested riparian zone in catchment, silviculture activity, and point source discharges. Reference sites would be defined as least-disturbed according to these criteria.	
Characterization of reference sites within a regional context	<input type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Stream stratification within regional reference conditions	<input checked="" type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input type="checkbox"/>	other:
Additional information	<input type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

Field and Lab Methods

Assemblages assessed	<input checked="" type="checkbox"/>	benthos (100-500 samples/year; single season, multiple sites - watershed level)
	<input checked="" type="checkbox"/>	fish (100-500 samples/year; single season, multiple sites - watershed level)
	<input type="checkbox"/>	periphyton
	<input type="checkbox"/>	other:
Benthos		
sampling gear		collect by hand and D-frame; 500-600 micron mesh
habitat selection		multihabitat
subsample size		200 count
taxonomy		genus
Fish		
sampling gear		seine, backpack electrofisher, pram unit (tote barge); 3/16" and 1/4" mesh
habitat selection		Sample all habitats within a sample reach that is 35X the mean stream width. Habitat assessments are broken out between riffle/run and glide/pool based on the ecoregion in which the sample is located.
sample processing		biomass – batch, anomalies
subsample		none
taxonomy		species
Habitat assessments		visual based and zig-zag pebble count; performed with bioassessments
Quality assurance program elements		standard operating procedures, quality assurance plan, periodic meetings and training for biologists, sorting and taxonomic proficiency checks

Data Analysis and Interpretation

Data analysis tools and methods	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	UD	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics (<i>aggregate metrics into an index</i>)
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
Multimetric thresholds		
transforming metrics into unitless scores		under development
defining impairment in a multimetric index		under development
Multivariate thresholds		
defining impairment in a multivariate index		under development
Evaluation of performance characteristics <i>Not currently evaluated</i>	<input type="checkbox"/>	repeat sampling
	<input type="checkbox"/>	precision
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
Biological data		
Storage		EDAS and Excel
Retrieval and analysis		EDAS

HAWAII

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Program Description

The primary objective of the Hawaii State Department of Health (HIDOH) Bioassessment Program is to augment the commonly used physical and chemical water quality assessments performed (during ambient monitoring, use attainability studies, and other investigations) for classification, evaluation and regulation of water bodies. The program primarily utilizes the Hawaii Stream Bioassessment Protocol (HSBP) 3.01 developed by Mike Kido and the Hawaii Natural Resources Conservation Service (NRCS) Visual Assessment protocol for characterization of streams. HIDOH currently uses these protocols in conjunction with water quality data to establish TMDLs in the State of Hawaii. In the future the HSBP and the Hawaii NRCS protocol will be used in conjunction with physical and chemical water quality data to classify streams and determine exceedances of narrative criteria.

The HSBP includes both habitat and biotic metrics. The general approach of the HSBP is to compare measures of community characteristics and habitat of a study stream to a minimally impacted ecoregional reference condition. An Index of Biotic Integrity, currently focused on fish, composes the biotic portion of the protocol. Much of the basis for evaluation is the presence or absence of native taxa and the introduction of non-native species. Low abundance or low diversity of native fauna suggests diminished biological integrity. The habitat portion of the HSBP includes standard habitat metrics, including bank stability, embeddedness, canopy cover and presence of fine and coarse organic material. The State of Hawaii will soon be working with USGS to census the macroinvertebrate community in Hawaii and develop metrics for the Hawaii Bioassessment Program, which will add a component to measure pollution tolerance. The macroinvertebrate community in Hawaii is quite different from that of the mainland United States; therefore, the metric may be quite unlike that of any other state.

As a preliminary evaluation of sites and to compliment the HSBP habitat component, the Hawaii NRCS Visual Assessment protocol is applied. This is a modified version of the national NRCS visual assessment protocol.

The State Water Quality Management Planner, along with a Stream Bioassessment Intern, primarily perform these assessments. Additionally, other scientists from HIDOH, scientists from other local, state and federal agencies, local university students and professors, and skilled community members volunteer their time to help perform these protocols. The time demand of each task is dependent upon the number of aquatic organisms in the stream, the size of the stream, and other local conditions. HIDOH currently sponsors training courses in the protocols to those with a scientific background on a limited basis.

Documentation and Further Information

excerpts from *Hawaii 2000 305(b) Report*: <http://www.hawaii.gov/health/eh/cwb/2000-305b/index.html>

Proposed 2001 revisions to *Hawaii Water Quality Standards, January 2002 Indicators of Environmental Quality Report*: <http://www.hawaii.gov/health/eh/epo/wqrev.htm>

Hawaii Stream Bioassessment Protocol, Michael Kido, Version 3.01, January 2001:
<http://www.state.hi.us/doh/eh/epo/kawa.pdf>

HAWAII

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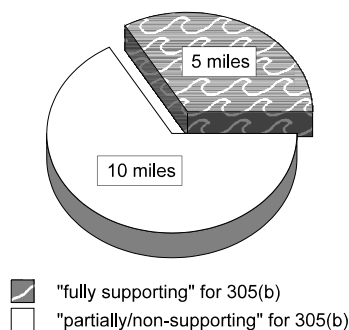
Programmatic Elements

Uses of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input type="checkbox"/>	monitoring the effectiveness of BMPs
	<input type="checkbox"/>	ALU determinations/ambient monitoring
	UD	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input type="checkbox"/>	other:
Applicable monitoring designs	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) (<i>special projects only</i>)
	<input type="checkbox"/>	fixed station (i.e., water quality monitoring stations)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin (<i>specific river basins or watersheds</i>)
	<input type="checkbox"/>	other:

Stream Miles

Total miles	249
<i>(determined using state based coverage)</i>	
Total perennial miles	249
Total miles assessed for biology	15
fully supporting for 305(b)	5
partially/non-supporting for 305(b)	10
listed for 303(d)	10
number of sites sampled (<i>on an annual basis</i>)	17
number of miles assessed per site*	<1

15 Miles Assessed for Biology



*Less than 1 mile assessed per site was determined by dividing the 15 total miles assessed for biology by the 17 sites sampled, which equals roughly .88 miles.

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Class System (A,B,C)	
ALU designations in state water quality standards	Two designations: 1) Protection of native breeding stock, and 2) Support and propagation of aquatic life	
Narrative Biocriteria in WQS	under development	
Numeric Biocriteria in WQS	under development – Hawai'i is currently proposing to add numeric biocriteria to WQS	
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input type="checkbox"/>	cause and effect determinations
	<input type="checkbox"/>	permitted discharges
	<input type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	none	

Reference Site/Condition Development

Number of reference sites	3 total	
Reference site determinations	<input type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input checked="" type="checkbox"/>	regional (aggregate of sites)
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Reference site criteria	Minimally impacted and most pristine. Always scores near 100% when using the Hawai'i Stream Bioassessment Protocol no matter when and where sampled.	
Characterization of reference sites within a regional context	<input type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Stream stratification within regional reference conditions	<input checked="" type="checkbox"/>	ecoregions (or some aggregate) (<i>the entire State of Hawai'i is one ecoregion</i>)
	<input type="checkbox"/>	elevation
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input type="checkbox"/>	other:
Additional information	<input type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

Field and Lab Methods

Assemblages assessed	<input type="checkbox"/> UD	benthos (<i>Hawai'i will soon be working with USGS to census the macroinvertebrate community in Hawai'i and develop metrics</i>)
	<input checked="" type="checkbox"/>	fish (<100 samples/year; single season, multiple sites - watershed level)
	<input type="checkbox"/>	periphyton
	<input type="checkbox"/>	other:
Fish		
sampling gear		backback electrofisher and snorkel
habitat selection		multihabitat
sample processing		length measurement and biomass - individual
subsample		selected species
taxonomy		species
Habitat assessments		visual based, habitat availability, substrate embeddedness, Fine and Coarse Particulate Organic Matter (FPOM/CPOM) characterization, velocity-depth combinations, channel flow status, channel alteration, bank stability, riparian vegetative zone width, riparian understory coverage, and percent native riparian plant coverage; performed with bioassessments
Quality assurance program elements		standard operating procedures, periodic meetings and training for biologists, and taxonomic proficiency checks

Data Analysis and Interpretation

Data analysis tools and methods	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input type="checkbox"/>	parametric ANOVAs
	<input type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics (<i>aggregate metrics into an index</i>)
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
Multimetric thresholds		
transforming metrics into unitless scores		under development
defining impairment in a multimetric index		under development*
Evaluation of performance characteristics	<input type="checkbox"/>	repeat sampling
<i>Not currently evaluated</i>	<input type="checkbox"/>	precision
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
Biological data		
Storage		Excel
Retrieval and analysis		Statistica

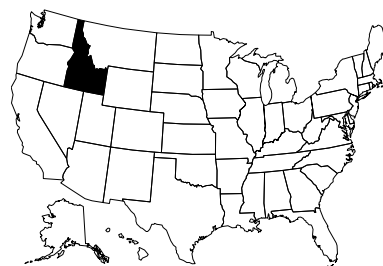
*The following are the *proposed* impairment thresholds:

	Class 1a (mainly undeveloped, "unimpaired")	Class 2a (mainly developed, "unimpaired")
Habitat	greater than or equal to 75% of reference condition	between 50% and 75% of reference condition
Biotic integrity	greater than or equal to 70% of reference condition	between 30% and 70% of reference condition

IDAHO

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Program Description

The Idaho surface water program uses biological information extensively to determine use support and impairment. In 1993, the Idaho Department of Environmental Quality (IDEQ) implemented a rapid bioassessment program aimed at integrating biological and chemical monitoring with physical habitat assessment as a way of characterizing water quality and stream integrity. This program, known as the Beneficial Use Reconnaissance Program (BURP), closely follows concepts and methods described in the *Rapid Bioassessment Protocols for Use in Streams and Rivers* (USEPA 1999). The main purpose of BURP is to provide consistency in monitoring, collecting data, and reporting. Specifically, biological along with physical, chemical, and landscape data are used to address the following objectives:

- Determine the degree of beneficial use support of the water body
- Determine the degree of biological integrity using biological information or other measures
- Compile descriptive information about the water body and data used in the assessment.

IDEQ has formal monitoring and assessment methods in place for large rivers and small streams. Methods for lakes and reservoirs are in development. For rivers and streams, there are a total of 8 multimetric indices for benthic macroinvertebrates, periphyton, fish, habitat, and physicochemical measures. Indices are integrated into attaining or non-attaining use support determinations. The integration uses a weight-of-evidence approach combined with individual minimum benchmarks for each assemblage and numeric criteria exceedances.

IDEQ has several plans to improve the current monitoring and assessment program. A draft statewide monitoring strategy will be introduced in July 2002. Future plans include incorporating a probabilistic monitoring design for screening purposes as well as adding methods for other water body types (e.g., wetlands, intermittent streams, springs, etc.). Implementation of these plans is dependent on agency priorities and available resources.

Documentation and Further Information

Idaho's 1998 303(d) List: http://www2.state.id.us/deq/water/1998_303d/303dlist.pdf

Grafe, C.S. et al. 2002. *Water body assessment guidance, 2nd edition*. Idaho Department of Environmental Quality. Boise, Idaho. 113 pp. http://www2.state.id.us/deq/water/surface_water/wbag/WBAG2001.htm

Grafe, C.S. (editor) April 2002. *Idaho small stream ecological assessment framework: an integrated approach*. Idaho Department of Environmental Quality. Boise, Idaho. 304 pp. http://www2.state.id.us/deq/water/surface_water/wbag/WBAG_AssessmentFramework.htm

Grafe, C.S. (editor). April 2002. *Idaho river ecological assessment framework: an integrated approach*. Idaho Department of Environmental Quality. Boise, Idaho. 222 pp. http://www2.state.id.us/deq/water/surface_water/wbag/WBAG_AssessmentFramework.htm

Beneficial Use Reconnaissance Program (BURP) 2001 Annual Work Plan for Wadeable (Small) Streams, 2001: http://www2.state.id.us/deq/water/surface_water/2001_BURP_annual_work_plan_wadeable_streams.pdf

BURP Quality Assurance Plan for Field Data Sheets on Wadeable (Small) Streams, 2001: http://www2.state.id.us/deq/water/surface_water/BURP_QualityAssurancePlan.pdf

1999 BURP Workplan for Wadeable Streams (Methods Manual): http://www2.state.id.us/deq/water/surface_water/99_BURP_WORKPLAN.pdf

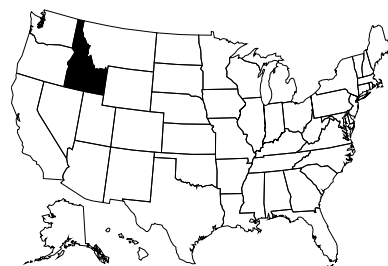
Streams: 1999 Post-Field Evaluation Summary Report (BURP), 2001: http://www2.state.id.us/deq/water/surface_water/BURP_streams_Field_Report_99.pdf

Public Involvement and Response to Comment Summary: http://www2.state.id.us/deq/water/surface_water/wbag/WBAG2001.htm

IDAHO

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Programmatic Elements

Uses of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input type="checkbox"/>	other:
Applicable monitoring designs	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) (<i>special projects, specific river basins or watersheds, and comprehensive use throughout jurisdiction</i>)
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) (<i>special projects only</i>)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input type="checkbox"/>	rotating basin
	<input type="checkbox"/>	other:

Stream Miles

Total miles **96,200**
(determined using the National Hydrography Database)

Total perennial miles 49,500

Total miles assessed for biology **16,742**

fully supporting for 305(b) 8,434

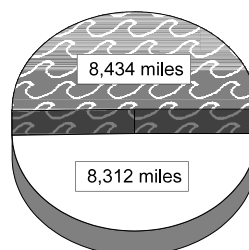
partially/non-supporting for 305(b) 8,312



listed for 303(d) 8,312

number of sites sampled 4,500

number of miles assessed per site ~3.5

16,742 Miles Assessed for Biology



 "fully supporting" for 305(b)
 "partially/non-supporting" for 305(b)

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Warm Water vs. Cold Water
ALU designations in state water quality standards	Sub-categories are cold water, seasonal cold water, warm water, modified (UAA required), and salmonid spawning.
Narrative Biocriteria in WQS	IDEQ's "Waterbody Assessment Guidance" and supporting technical reports are used to interpret and implement WQS, including ALU assessment. Although the term "biocriteria" is not used, functional elements are included in the WQS and in implementing ALU designation and support status guidance. Please see: http://www2.state.id.us/adm/adminrules/rules/IDAPA58/58INDEX.HTM
Numeric Biocriteria in WQS	none
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/> assessment of aquatic resources <input checked="" type="checkbox"/> cause and effect determinations <input checked="" type="checkbox"/> permitted discharges <input checked="" type="checkbox"/> monitoring (e.g., improvements after mitigation) <input checked="" type="checkbox"/> watershed based management
Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	<p>Used as restoration criteria in CERCLA cleanup monitoring effectiveness plans/consent decrees; bioassessment is required prior to removing 303(d) listed waters</p> <p>Most TMDLs have ALUS biomonitoring as part of implementation; one recent example is the North Fork of the Coeur d'Alene River.</p>

Reference Site/Condition Development

Number of reference sites	200 total
Reference site determinations	<input type="checkbox"/> site-specific <input type="checkbox"/> paired watersheds <input checked="" type="checkbox"/> regional (aggregate of sites) <input checked="" type="checkbox"/> professional judgment <input type="checkbox"/> other:
Reference site criteria	Reference site criteria based on nearby road condition, riparian vegetation complexity, channel morphology and complexity, habitat structure complexity, evidence of chemical stressors, substrate heterogeneity, and evidence of point and nonpoint sources. Also, land satellite images are reviewed for evidence of disturbance in the watershed (see IDAPA 58.01.02.003.85).
Characterization of reference sites within a regional context	<input type="checkbox"/> historical conditions <input checked="" type="checkbox"/> least disturbed sites <input type="checkbox"/> gradient response <input checked="" type="checkbox"/> professional judgment <input checked="" type="checkbox"/> other: mostly least disturbed sites, but also minimally disturbed sites in some bioregions
Stream stratification within regional reference conditions	<input type="checkbox"/> ecoregions (or some aggregate) <input type="checkbox"/> elevation <input type="checkbox"/> stream type <input type="checkbox"/> multivariate grouping <input type="checkbox"/> jurisdictional (i.e., statewide) <input checked="" type="checkbox"/> other: bioregions based on groupings of ecoregions. Some of the indices classify by elevation and stream type.
Additional information	<input checked="" type="checkbox"/> reference sites linked to ALU <input type="checkbox"/> reference sites/condition referenced in water quality standards <input checked="" type="checkbox"/> some reference sites represent acceptable human-induced conditions

Field and Lab Methods

Assemblages assessed	<input checked="" type="checkbox"/>	benthos (100-500 samples/year; single season, multiple sites - broad coverage)
	<input checked="" type="checkbox"/>	fish (100-500 samples/year; single season, multiple sites - broad coverage)
	<input checked="" type="checkbox"/>	periphyton (100-500 samples/year; single season, multiple sites - broad coverage)
	<input type="checkbox"/>	other:
Benthos		
sampling gear		Surber, Hess, Slack (0.5 meter, in rivers only); 500-600 micron mesh
habitat selection		richest habitat
subsample size		500 count
taxonomy		species
Fish		
sampling gear		backpack electrofisher
habitat selection		multihabitat
sample processing		length measurement, biomass - individual, biomass - batch and anomalies
subsample		none; full sample work-up
taxonomy		species (count and keep voucher specimens for species that are not identified in the field)
Periphyton		
sampling gear		natural substrate: brushing/scraping device (razor, toothbrush, etc.)
habitat selection		selected near macroinvertebrate sample
sample processing		taxonomic identification
taxonomy		species level
Habitat assessments		visual based, canopy closure (densiometer), Wolman pebble count, pool complexity (width, depth), stream width/depth, large woody debris; performed with bioassessments
Quality assurance program elements		standard operating procedures, quality assurance plan, periodic meetings and training for biologists, sorting and taxonomic proficiency checks, specimen archival

Data Analysis and Interpretation*

Data analysis tools and methods	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input checked="" type="checkbox"/>	parametric ANOVAs
	<input checked="" type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics (<i>aggregate metrics into an index</i>)
	<input checked="" type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
Multimetric thresholds		
transforming metrics into unitless scores		Varies by index - a combination of 95 th percentile of reference and cumulative distribution function used to scale metrics scores is most frequently used.
defining impairment in a multimetric index		25 th percentile of reference population**
Evaluation of performance characteristics	<input checked="" type="checkbox"/>	repeat sampling
	<input checked="" type="checkbox"/>	precision (<i>variability study of reference conditions</i>)
	<input checked="" type="checkbox"/>	sensitivity
	<input checked="" type="checkbox"/>	bias
	<input checked="" type="checkbox"/>	accuracy
Biological data		
Storage		MS Access, changing to Oracle/Visual Basic indexed to NHD
Retrieval and analysis		Custom interface (Biological Assessment Tool) developed to calculate metrics, indices, and physical and biological summary statistics. Systat is also used.

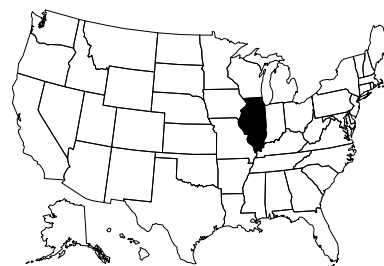
*Formal methods have been developed for non-wadeable rivers and wadeable streams. Lentic methods are under development. A total of eight multimetric indices for bugs, diatoms, fish, habitat, and physicochemical measures have been developed or adapted for rivers and streams. Indices are integrated into attaining or non-attaining use support determinations.

**Idaho uses a measure of CONDITION, which aggregates 3 different indices - Habitat, Benthos and Fish. Each index is compared to the median of reference condition and is given a score of 1, 2 or 3. All three scores are then combined (averaged). If > or = 2, then fully supporting; if <2, then not supporting.

ILLINOIS

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Program Description

Illinois EPA (IEPA) conducts intensive river basin surveys on a five-year rotational basis in cooperation with the [Illinois Department of Natural Resources \(IDNR\)](#). These surveys are a major source of information for annual 305(b) assessments. Illinois has 33 major river basins within its borders. Stations sampled by IEPA and IDNR are selected on the basis of where intensive data are currently lacking or historical data need updating. Water chemistry and biological (fish and macroinvertebrate) data along with qualitative and quantitative instream habitat information, including stream discharge, are collected to characterize stream segments within the basin, identify water quality conditions, and evaluate aquatic life use impairment. Fish tissue contaminant and sediment chemistry sampling are also conducted to screen for the accumulation of toxic substances.

Illinois' "biological expectations" are based on a regional reference site approach that enables within-region comparisons between the aquatic community at any stream site and the reference expectation. The regional reference site approach is a key component of biocriteria. The approach ensures reasonably attainable biological goals that recognize and account for the unique combination of regional land form, land use, and physical habitat characteristics, which influence the distribution of fish, macroinvertebrates and other aquatic organisms. Illinois is currently developing this framework, which includes refinement of existing biological assessment tools and, where needed, development of new state-of-the-art monitoring approaches.

Illinois EPA is working with IDNR, USEPA, members of the agricultural, industrial, academic and regulated communities, as well as outside contractors, and other interested parties to develop biological criteria for streams and rivers. This approach to biocriteria will enable IEPA to better assess the ecological/environmental quality of Illinois rivers and streams and should allow the Agency to continue to update and refine the stream use designations contained in Illinois' water quality standards.

Documentation and Further Information

Illinois Water Quality Report 2002 (CWA Section 305(b) Report), July 2002, IEPA, Bureau of Water:
<http://www.epa.state.il.us/water/water-quality/report-2002/305b-2002.pdf>

2001 305(b) Summary Report (1999 data), Rivers and Streams:
<http://www.epa.state.il.us/water/water-quality/report-2001/report-2001.pdf>

Condition of Illinois Water Resources - menu of Illinois 305(b) Reports and Assessments, including maps and graphs: <http://www.epa.state.il.us/water/water-quality/index.html>

Illinois Targeted Watershed Approach: <http://www.epa.state.il.us/water/targeted-watershed/index.html>

IEPA Bureau of Water, Surface Water Quality Monitoring and Assessment Programs homepage:
<http://www.epa.state.il.us/water/surface-water/index.html>

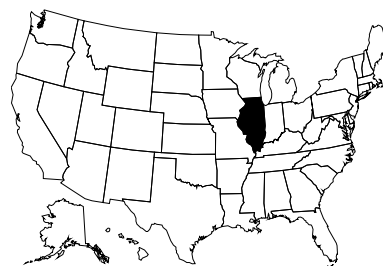
IEPA Bureau of Water, River and Stream Monitoring Program homepage, with links to biocriteria development and other relevant information: <http://www.epa.state.il.us/water/surface-water/river-stream-mon.html>

Hite, R.L. and B.A. Bertrand. 1989. *Biological Stream Characterization (BSC): A Biological Assessment of Illinois Stream Quality*, Special Report No. 13 of the Illinois State Water Plan Task Force. Illinois Environmental Protection Agency.

ILLINOIS

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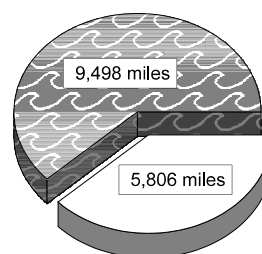
Programmatic Elements

Uses of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	UD	promulgated into state water quality standards as biocriteria
	<input checked="" type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
	<input type="checkbox"/>	other:
Applicable monitoring designs	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) (<i>special projects and specific river basins or watersheds</i>)
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) (<i>comprehensive use throughout jurisdiction</i>)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input type="checkbox"/>	probabilistic by ecoregion, or statewide
	<input checked="" type="checkbox"/>	rotating basin (<i>comprehensive use throughout jurisdiction</i>)
	<input type="checkbox"/>	other:

Stream Miles

Total miles	86,021
<i>(determined using RF3 and existing maps)</i>	
Total perennial miles	30,246
Total miles assessed for biology	15,304
fully supporting for 305(b)	9,498
partially/non-supporting for 305(b)	5,806
listed for 303(d)*	—
number of sites sampled	115
number of miles assessed per site**	site specific

15,304 Miles Assessed for Biology



- ☒ "fully supporting" for 305(b)
- ☐ "partially/non-supporting" for 305(b)

*Total miles listed for 303(d) is a subset of the miles partially/non-supporting for 305(b) and will be determined in the next update.

**10 miles for wadeable sites and 25 miles for non-wadeable sites with some site-specific detailing following the 1997 305(b) guidance.

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Single Aquatic Life Use	
ALU designations in state water quality standards	Secondary contact and indigenous aquatic life use waters (IL Title 35, Subtitle C, Chapter I, Part 303.204)	
Narrative Biocriteria in WQS	under development - IEPA has written guidelines and thresholds for fish and invertebrate indices that are not part of the WQS, but are in the 305(b) guidelines (see flowchart). These numeric biological measures are used as decision criteria to determine attainment of ALU.	
Numeric Biocriteria in WQS	none	
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input checked="" type="checkbox"/>	permitted discharges
	<input checked="" type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	Data have been used to make permitting and nonpoint source BMP decisions. Illinois DNR's Biological Stream Characterization (BSC) program is used to determine antidegradation tiers and to influence IDNR natural heritage area designations.	

Reference Site/Condition Development*

Number of reference sites	120 total	
Reference site determinations*	<input checked="" type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input type="checkbox"/>	regional (aggregate of sites)
	<input type="checkbox"/>	professional judgment
	<input checked="" type="checkbox"/>	other: watershed measures of physical and chemical disturbance
Reference site criteria	Illinois EPA is in the process of formally defining reference criteria.*	
Characterization of reference sites within a regional context	<input checked="" type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input checked="" type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Stream stratification within regional reference conditions	<input checked="" type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input checked="" type="checkbox"/>	stream type
	<input checked="" type="checkbox"/>	multivariate grouping
	<input checked="" type="checkbox"/>	jurisdictional (i.e., statewide)
	<input type="checkbox"/>	other:
Additional information	<input type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

*IEPA currently does not use "reference conditions" for making use-support decisions. Reference conditions were not explicitly defined or used for the present stream IBIs. A not-yet completed reevaluation of Illinois IBIs used reference conditions to develop the new indices. IEPA uses a general concept of least impacted reference condition where there are no data available; no further quantitative development has been done.

Field and Lab Methods

Assemblages assessed	<input checked="" type="checkbox"/>	benthos (100-500 samples/year; single season, multiple sites – not at watershed level)
	<input checked="" type="checkbox"/>	fish (100-500 samples/year; single season, multiple sites – not at watershed level)
	<input type="checkbox"/>	periphyton
	<input type="checkbox"/>	other:
Benthos		
sampling gear		collect by hand, dipnet; 500-600 micron mesh
habitat selection		richest habitat, riffle/run (cobble), multihabitat and woody debris
subsample size		300 count and entire sample
taxonomy		combination - order, family, genus and species
Fish		
sampling gear		backpack and boat electrofishers, and seine; 1/4" and 3/8" mesh
habitat selection		pool/glide, riffle/run (cobble) and multihabitat
sample processing		length measurement, biomass - individual and batch
subsample		none
taxonomy		species
Habitat assessments		visual based and quantitative measurements; performed with bioassessments
Quality assurance program elements		standard operating procedures, quality assurance plan, periodic meetings and training for biologists, sorting and taxonomic proficiency checks

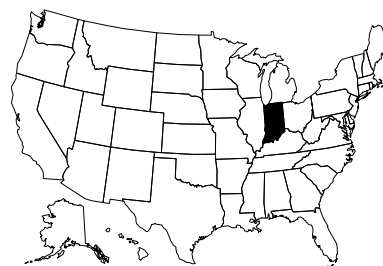
Data Analysis and Interpretation

Data analysis tools and methods	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input checked="" type="checkbox"/>	parametric ANOVAs
	<input checked="" type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics (<i>aggregate metrics into an index</i>)
	<input checked="" type="checkbox"/>	disturbance gradients
	<input checked="" type="checkbox"/>	other: nonparametric statistical tests
Multimetric thresholds		
transforming metrics into unitless scores		Metric values representing least-disturbed conditions statewide are stratified by region; within-region regression of each metric vs. environmental covariate, e.g., stream size and slope, defines benchmark for defining metric-scoring ranges.
defining impairment in a multimetric index		Thresholds are based on the possible index scoring range divided into discrete categories and are not driven by reference sites.
Evaluation of performance characteristics <i>Not currently evaluated</i>	<input type="checkbox"/>	repeat sampling
	<input type="checkbox"/>	precision
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
Biological data		
Storage		IEPA database and spreadsheets
Retrieval and analysis		SAS, Systat, database, spreadsheet, statistical-analysis and statistical-graphics applications, including MS Access, FoxPro, Excel, QuattroPro, Minitab, and Sigma Plot

INDIANA

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Program Description

The Biological Studies Section (BSS) of IDEM's Office of Water Quality conducts studies of fish and macroinvertebrate communities, as well as stream habitats. These data are used to help develop biological criteria to which all other streams can be compared in order to identify impaired streams or watersheds. BSS also conducts fish tissue and sediment sampling to monitor sources of toxic and bioconcentrating substances too low to be detected in other environmental media. Fish tissue data serve as the basis for fish consumption advisories issued to protect the health of people who consume fish caught in Indiana waters. Fish tissue data are also useful for wildlife health risk assessments for fish-eating birds and mammals, and for providing the information needed to develop models for assessing changes in the quality of Indiana ecosystems.

The BSS is responsible for determining the biological integrity of aquatic communities of Indiana streams and lakes. This is accomplished through a variety of field and laboratory studies that involve several different forms of aquatic life. These data are used to determine compliance with the existing narrative biological criteria in Indiana's current water quality standards, to determine the use attainability, and to make correlations to physical and/or chemical impairments which may exist.

The BSS participates in the review of requests for site-specific water quality criteria for waters influenced by NPDES discharges. In the course of its various monitoring and assessment field activities, the staff finds point and nonpoint source-related problems, which are then referred to the appropriate IDEM programs. The Section also cooperates in the monitoring and assessment of the Ohio River in conjunction with the Ohio River Valley Water Sanitation Commission (ORSANCO), and other state and federal agencies.

Lake and reservoir assessments prior to 1989 were conducted by the State and have since been contracted to Indiana University, School of Public and Environmental Affairs. From 1990 through 1995, the State in conjunction with USEPA - Region 5, conducted a statewide ecoregion-based fish community study. Indiana has historically collected macroinvertebrate community samples at a network of fixed stations. In addition the State has been conducting macroinvertebrate community assessments at wadeable stream sites since 1990. Since 1996 the biological assessments for fish and invertebrate community assessments have been conducted using probabilistic sampling on a rotational watershed basis as per Indiana's *Surface Water Quality Monitoring Strategy*. In 2000 the State participated in a study to determine if fish and macroinvertebrate indices could be developed for lakes and reservoirs. Conclusions are still pending.

Documentation and Further Information

Indiana 2001 - 2005 Surface Water Quality Monitoring Strategy:
<http://www.in.gov/idem/water/assessbr/016surfwaterqualmonstrat.pdf>

Indiana 303(d) List of Impaired Waterbodies, information and links:
<http://www.in.gov/idem/water/planbr/wqs/303d.html>

Indiana Water Quality 305(b) Report, general information: <http://www.IN.gov/idem/water/planbr/wqs/quality.html>

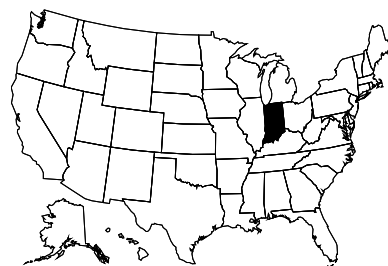
Indiana Water Quality Standards: <http://www.state.in.us/legislative/iac/title327.html>

IDEM Office of Water Quality's Assessment Branch - Biological Studies Section homepage, with numerous links to relevant fact sheets and reports: <http://www.in.gov/idem/water/assessbr/biostud/index.html>

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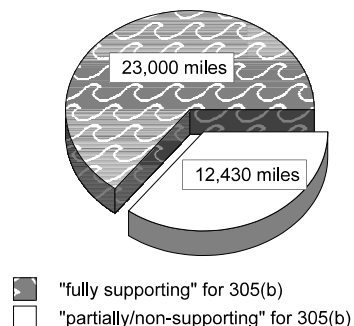
Programmatic Elements

Uses of bioassessment within overall water quality program	✓	problem identification (screening)
	✓	nonpoint source assessments
	✓	monitoring the effectiveness of BMPs
	✓	ALU determinations/ambient monitoring
	UD	promulgated into state water quality standards as biocriteria
	✓	support of antidegradation
	✓	evaluation of discharge permit conditions
	✓	TMDL assessment and monitoring
		other:
Applicable monitoring designs	✓	targeted (i.e., sites selected for specific purpose) (<i>specific river basins or watersheds and comprehensive use throughout jurisdiction</i>)
	✓	fixed station (i.e., water quality monitoring stations) (<i>specific river basins or watersheds and comprehensive use throughout jurisdiction</i>)
	✓	probabilistic by stream order/catchment area (<i>specific river basins or watersheds and comprehensive use throughout jurisdiction</i>)
	✓	probabilistic by ecoregion, or statewide (<i>specific river basins or watersheds and comprehensive use throughout jurisdiction</i>)
	✓	rotating basin (<i>specific river basins or watersheds and comprehensive use throughout jurisdiction</i>)
		other:

Stream Miles

Total miles	35,673
<i>(determined using RF3 and the National Hydrography Database)</i>	
Total perennial miles	21,094
Total miles assessed for biology	35,430
fully supporting for 305(b)	23,000
partially/non-supporting for 305(b)	12,430
listed for 303(d)	unknown
number of sites sampled (<i>on an annual basis</i>)	< 200
number of miles assessed per site	site specific

35,430 Miles Assessed for Biology



Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Warm Water vs. Cold Water
ALU designations in state water quality standards	Two designations: Well balanced warmwater aquatic community and Cold water put-and-take trout waters
Narrative Biocriteria in WQS	under development - The narrative biocriteria in Indiana have only been proposed and are not formal. They are loosely defined by 327 IAC 2-1-3(a)(2), 327 IAC-2-1-9 (49); and for the Great Lakes waters 327 IAC 2-1.5-5(a)(2) and (3), and 327 IAC 2-1.5-2 (92). IDEM uses informal numeric procedures to support narrative biocriteria (see http://www.in.gov/IDEM/water/planbr/wqs/quality.html).
Numeric Biocriteria in WQS	none
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/> assessment of aquatic resources <input checked="" type="checkbox"/> cause and effect determinations <input type="checkbox"/> permitted discharges <input checked="" type="checkbox"/> monitoring (e.g., improvements after mitigation) <input checked="" type="checkbox"/> watershed based management
Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	Biological assessment data are used for 305(b)/303(d) purposes and was used for the FY 2000 Unified Watershed Assessment (updated 2001), which was used for the Watershed Restoration Action Strategies.

Reference Site/Condition Development*

Number of reference sites	unknown
Reference site determinations	<input type="checkbox"/> site-specific <input type="checkbox"/> paired watersheds <input checked="" type="checkbox"/> regional (aggregate of sites) <input checked="" type="checkbox"/> professional judgment <input type="checkbox"/> other:
Reference site criteria	Deviation from central tendencies on multimetric indices and the qualitative habitat evaluation index (QHEI) is also taken into consideration when evaluating impairment. Field chemistry is measured and probabilistic sites are sampled for broad chemical analysis.
Characterization of reference sites within a regional context	<input checked="" type="checkbox"/> historical conditions** <input checked="" type="checkbox"/> least disturbed sites <input checked="" type="checkbox"/> gradient response <input type="checkbox"/> professional judgment <input checked="" type="checkbox"/> other: IBI is calibrated on drainage area for headwater streams, wadeable rivers, large rivers and great rivers
Stream stratification within regional reference conditions	<input checked="" type="checkbox"/> ecoregions (or some aggregate) <input type="checkbox"/> elevation <input type="checkbox"/> stream type <input checked="" type="checkbox"/> multivariate grouping <input type="checkbox"/> jurisdictional (i.e., statewide) <input checked="" type="checkbox"/> other: 8 digit USGS Hydrologic Unit Codes
Additional information	<input checked="" type="checkbox"/> reference sites linked to ALU (<i>in a statistical sense</i>) <input type="checkbox"/> reference sites/condition referenced in water quality standards <input checked="" type="checkbox"/> some reference sites represent acceptable human-induced conditions (<i>it is understood that all sites have a human-induced condition</i>)

*IDEM uses a non-typical process for developing reference condition: reference condition is represented by a percentage of the total population of the sites sampled. The number of reference sites in Indiana is not available at this time.

**Reference condition is defined by a historical cross-section of sample sites representing the full gradient of ecological conditions as they existed during statewide or ecoregion specific investigation.

Field and Lab Methods

Assemblages assessed	<input checked="" type="checkbox"/>	benthos (<100 samples/year; single season, multiple sites - broad coverage)
	<input checked="" type="checkbox"/>	fish (<100 samples/year; single season, multiple sites - broad coverage)
	<input checked="" type="checkbox"/>	periphyton (<100 samples/year; solely through a pilot contract with USGS)
	<input checked="" type="checkbox"/>	other: phytoplankton and zooplankton (<100 samples/year; single observation, limited sampling)
Benthos		
sampling gear		multiplate, dipnet, and kick net (1 meter); 243-600 micron mesh
habitat selection		riffle/run (cobble) and artificial substrate in the absence of riffle/run
subsample size		100 count and proportional/volume
taxonomy		family
Fish		
sampling gear		backpack, boat, longline and pram unit (tote barge) electrofishers; and 1/8" mesh seine
habitat selection		multihabitat
sample processing		enumeration, length measurement, biomass - batch, and anomalies
subsample		none
taxonomy		species
Habitat assessments		visual based; performed with bioassessments
Quality assurance program elements		standard operating procedures, quality assurance plan, periodic meetings and training for biologists, sorting and taxonomic proficiency checks, specimen archival

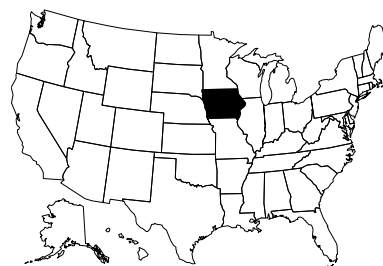
Data Analysis and Interpretation

Data analysis tools and methods	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input checked="" type="checkbox"/>	parametric ANOVAs
	<input checked="" type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics (<i>aggregate metrics into an index</i>)
	<input checked="" type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
Multimetric thresholds		
transforming metrics into unitless scores		cumulative distribution function
defining impairment in a multimetric index		cumulative distribution function and use various break points for impairments
Multivariate thresholds		
defining impairment in a multivariate index		significant departure from mean of reference population
Evaluation of performance characteristics	<input checked="" type="checkbox"/>	repeat sampling (<i>watersheds are sampled on 5 yr rotational basis</i>)
	<input checked="" type="checkbox"/>	precision (<i>Standard Error, 95% Confidence Interval and Relative Percent Difference</i>)
	<input type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input checked="" type="checkbox"/>	accuracy (<i>10% field duplicates, 10% laboratory duplicates</i>)
Biological data		
Storage		Assessment Information Management System (AIMS), MS Access based utility, and some historical data still in paper files
Retrieval and analysis		Statistica and MINITAB for cluster analysis of large matrices

IOWA

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IDNR Water Quality Bureau: <http://www.state.ia.us/dnr/organiza/epd/wtrq/wtrqbur.htm>



Program Description

Since 1994, the Iowa Department of Natural Resources (IDNR) and the University Hygienic Laboratory (UHL) have conducted a biological assessment program for Iowa's Wadeable streams and rivers. So far, biological sampling has been conducted at 289 stream locations throughout the state. Biological data are collected for a variety of purposes including: ambient monitoring, problem investigation, evaluation of point source and nonpoint source pollution control measures, and TMDL development. The IDNR uses bioassessment information to assess the status of stream aquatic life designated uses for the Section 305(b) report and the Section 303(d) list of impaired waters.

Benthic macroinvertebrates and fish serve as indicators of stream biological integrity. Standardized sampling procedures are used to collect species composition and proportional abundance data from which a suite of biological metrics is calculated. Individual metric values are aggregated to obtain scores for the Benthic Macroinvertebrate Index of Biotic Integrity (BMIBI) and the Fish Index of Biotic Integrity (FIBI). Biological impairment thresholds are based on the statistical distribution of biotic index scores obtained from stream reference site sampling. Currently, the IDNR has identified 96 reference sites that represent least disturbed stream conditions in Iowa's ten ecological regions.

Until 2002, a targeted approach was used to select sampling locations for Iowa's stream biological assessment program. From 1994 through 1998, the program emphasized candidate reference site and test (impacted) site sampling, which provided data for evaluating and calibrating biological data metrics. From 1999-2001, the emphasis shifted toward site-specific problem investigation and follow-up. Beginning in 2002, IDNR and UHL are initiating a probabilistic survey that will provide an unbiased, statistically powerful assessment of Iowa's perennial streams and rivers. The survey design calls for sampling 56 randomly-selected sites per year through 2005. During this period, IDNR and UHL also plan to resample the existing network of reference streams at a rate of 20-25 sites per year.

The IDNR is working toward incorporating narrative and numeric stream biocriteria in Iowa's water quality standards. The bioassessment framework that is currently used for 305(b) assessments can potentially serve as a foundation for biocriteria. The 2002-2005 probabilistic survey will provide useful data from non-wadeable streams and rivers for biocriteria development. Biocriteria development for Iowa's lakes, reservoirs, and wetlands has not been initiated.

Documentation and Further Information

Water Quality in Iowa During 1998 and 1999 (Iowa's 2000 Section 305(b) report):
<http://www.state.ia.us/dnr/organiza/epd/wtrq/305b00/index.htm>

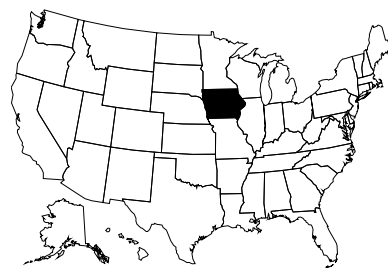
Final Approved Iowa 1998 303(d) List: <http://www.state.ia.us/dnr/organiza/epd/wtresrce/files/303dlist.pdf>

Iowa's STORET Database (ambient water quality program dataset): <http://wqm.igsb.uiowa.edu/storet/>

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Programmatic Elements

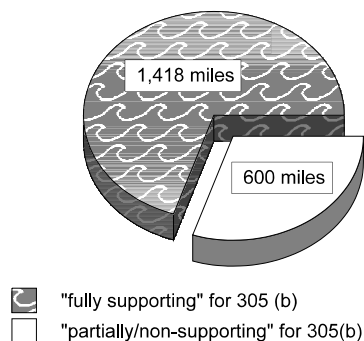
Uses of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input type="checkbox"/>	support of antidegradation
	<input type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
Applicable monitoring designs*	<input type="checkbox"/>	other:
	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) (<i>special projects, specific river basins or watersheds, comprehensive use throughout jurisdiction</i>)
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) (<i>specific river basins or watersheds</i>)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input checked="" type="checkbox"/>	probabilistic by ecoregion, or statewide (<i>comprehensive use throughout jurisdiction</i>)
	<input type="checkbox"/>	rotating basin
	<input type="checkbox"/>	other:

*In 2002, IDNR will initiate a REMAP probabilistic survey of perennial streams and rivers.

Stream Miles

Total miles	71,665
<i>(State based determination)</i>	
Total perennial miles	26,630
Total miles assessed for biology*	2,018
fully supporting for 305(b)	1,418
partially/non-supporting for 305(b)	600
listed for 303(d)	n/a
number of sites sampled	149
number of miles assessed per site	0.1 - 0.22

2,018 Miles Assessed for Biology



*Stream miles reported are based on Iowa's 2000 305(b) assessment. A 303(d) list was not prepared in 2000.

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Class System (A, B, C), Warm Water vs. Cold Water	
ALU designations in state water quality standards	Four designations: B(LR) - limited resource warmwater streams/rivers; B(WW) - significant resource warmwater streams/rivers; B(CW) - coldwater streams; B(LW) - lakes and wetlands	
Narrative Biocriteria in WQS	under development (Iowa's water quality standards include language associated with ALUs but it was not intended to be formal narrative biocriteria. IA is moving toward incorporating narrative biocriteria into the State's water quality standards.)	
Numeric Biocriteria in WQS	none (IA uses thresholds to report data in 305(b) report, but not formal numeric biocriteria.)	
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/>	assessment of aquatic resources
	<input checked="" type="checkbox"/>	cause and effect determinations
	<input type="checkbox"/>	permitted discharges
	<input checked="" type="checkbox"/>	monitoring (e.g., improvements after mitigation)
	<input checked="" type="checkbox"/>	watershed based management
Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	303(d) listing, to address point source impacts, and to support TMDL development	

Reference Site/Condition Development

Number of reference sites	96 total	
Reference site determinations	<input type="checkbox"/>	site-specific
	<input type="checkbox"/>	paired watersheds
	<input checked="" type="checkbox"/>	regional (aggregate of sites)
	<input checked="" type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Reference site criteria	Regionally representative and least disturbed by human activities, consider impact of livestock waste, wastewater, channel alterations, riparian land use, and quality of instream habitat	
Characterization of reference sites within a regional context	<input type="checkbox"/>	historical conditions
	<input checked="" type="checkbox"/>	least disturbed sites
	<input type="checkbox"/>	gradient response
	<input type="checkbox"/>	professional judgment
	<input type="checkbox"/>	other:
Stream stratification within regional reference conditions	<input checked="" type="checkbox"/>	ecoregions (or some aggregate)
	<input type="checkbox"/>	elevation
	<input type="checkbox"/>	stream type
	<input type="checkbox"/>	multivariate grouping
	<input type="checkbox"/>	jurisdictional (i.e., statewide)
	<input type="checkbox"/>	other:
Additional information	<input type="checkbox"/>	reference sites linked to ALU
	<input type="checkbox"/>	reference sites/condition referenced in water quality standards
	<input checked="" type="checkbox"/>	some reference sites represent acceptable human-induced conditions

Field and Lab Methods

Assemblages assessed	<input checked="" type="checkbox"/>	benthos (<i>100 - 500 samples per year; single season, multiple sites - broad coverage</i>)
	<input checked="" type="checkbox"/>	fish (<i><100 samples per year; single season, multiple sites - broad coverage</i>)
	<input type="checkbox"/>	periphyton
	<input type="checkbox"/>	other:
Benthos		
sampling gear		Surber, Hess, multiplate, collect by hand; 500 - 600 micron mesh
habitat selection		riffle/run (cobble), multihabitat, artificial substrate
subsample size		100 count, entire sample
taxonomy		combination - order, family, genus, species
Fish		
sampling gear		backpack electrofisher, pram unit (tote barge); 3/16" mesh
habitat selection		multihabitat
sample processing		anomalies, species abundance
subsample		none
taxonomy		species
Habitat assessments		visual based, quantitative measurements; performed with bioassessments
Quality assurance program elements		standard operating procedures, periodic meetings/training for biologists, taxonomic proficiency checks, specimen archival

Data Analysis and Interpretation

Data analysis tools and methods	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input checked="" type="checkbox"/>	parametric ANOVAs
	<input checked="" type="checkbox"/>	multivariate analysis (<i>for data exploration only</i>)
	<input checked="" type="checkbox"/>	biological metrics (<i>aggregate metrics into an index</i>)
	<input checked="" type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
Multimetric thresholds		
transforming metrics into unitless scores		linear interpolation between optimum (95%) reference population level and the minimum level
defining impairment in a multimetric index		25 th percentile of reference population
Evaluation of performance characteristics	<input checked="" type="checkbox"/>	repeat sampling
	<input checked="" type="checkbox"/>	precision
	<input checked="" type="checkbox"/>	sensitivity
	<input type="checkbox"/>	bias
	<input type="checkbox"/>	accuracy
Biological data		
Storage		EDAS (benthic macroinvertebrate data) and MS Access (fish, physical habitat, and water chemistry data)
Retrieval and analysis		STATISTIX (Analytical Software) and Excel